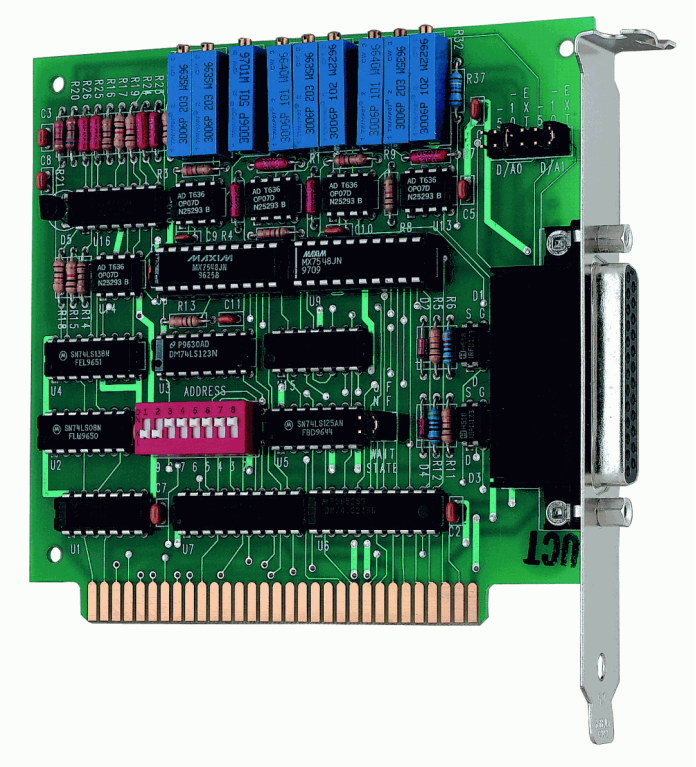
CIO-DAC02

Two Channel Voltage or Current Output

User's Guide



MEASUREMENT COMPUTING™

CIO-DAC02

Analog Output Board

User's Guide

Document Revision 5A, March, 2010

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Table of Contents

About this User's Guide

What you will learn from this user's guide

This user's guide explains how to install, configure, and use the CIO-DAC02 board so that you get the most out of its analog output features. This user's guide also refers you to related documents available on our web site, and to technical support resources.

Conventions in this user's guide

The following conventions are used in this manual to convey special information:

For more information on …

Text presented in a box signifies additional information and helpful hints related to the subject matter you are reading.

Shaded caution statements present information to help you avoid injuring yourself and others, damaging your hardware, or losing your data.

<#:#> Angle brackets that enclose numbers separated by a colon signify a range of numbers, such as those assigned to registers, bit settings, etc.

bold text **Bold** text is used for the names of objects on the screen, such as buttons, text boxes, and check boxes. For example:
1. Insert the disk or CD and click the **OK** button.

italic text *Italic* text is used for the names of manuals and help topic titles, and to emphasize a word or phrase. For example:
The *Insta*Cal installation procedure is explained in the *Quick Start Guide*.
Never touch the exposed pins or circuit connections on the board.

Where to find more information

For additional information relevant to the operation of your hardware, refer to the *Documents* subdirectory where you installed the MCC DAQ software (C:\Program Files\Measurement Computing\DAQ by default), or search for your device on our website at www.mccdaq.com.

If you need to program at the register level in your application, refer to the *Register Map for the CIO-DAC02*. This document is available on our website at www.mccdaq.com/registermaps/RegMapCIO-DAC02.pdf.

Introducing the CIO-DAC02

Overview: CIO-DAC02 features

The CIO-DAC02 provides two channels of 12-bit analog voltage or current output. Each analog output is controlled by a 12-bit D/A converter. A 12-bit converter provides 1/4096 parts resolution. On a scale of 0-5 volts, the output can be controlled to within 1.22 mV.

The output voltage reference for each D/A is jumper-selectable for Bipolar or Unipolar. Bipolar ranges are ±10 V and ±5 V. Unipolar ranges are 0 to 10 V, 0 to 5 V, and 4 to 20 mA. You can also provide an external voltage reference via connections to the board's 25-pin connector.

The board also features a wait state generator that you enable with an on-board jumper.

CIO-DAC02 block diagram

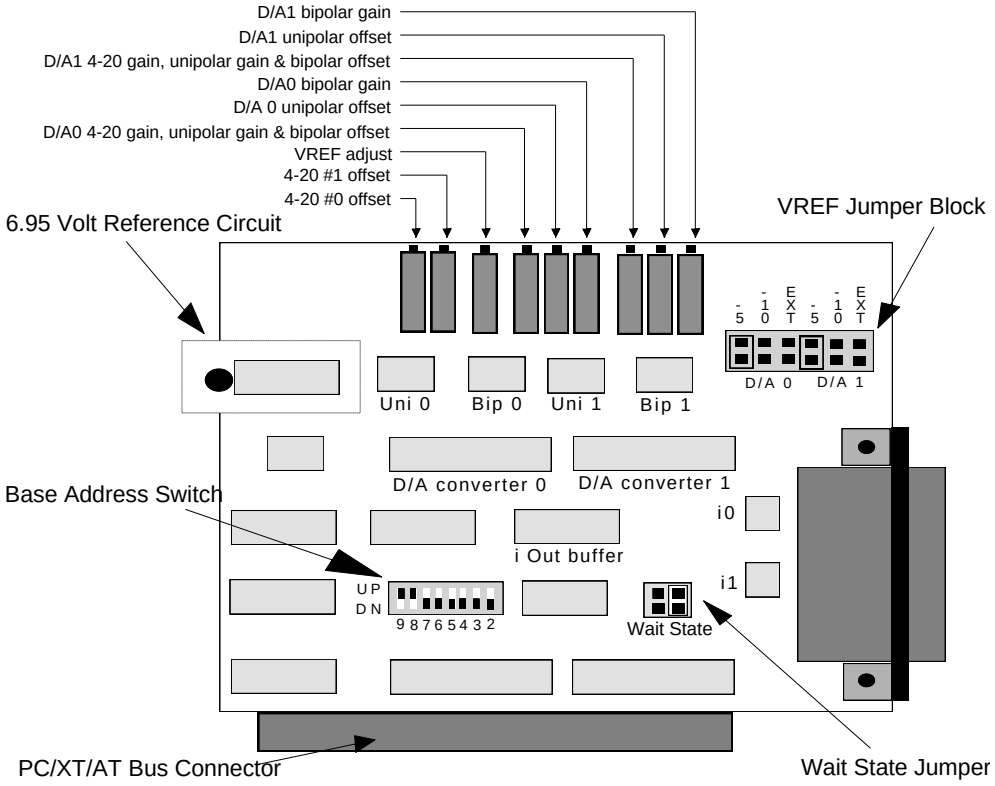

Figure 1. CIO-DAC02 functional block diagram

Software features

For information on the features of *Insta*Cal and the other software included with your CIO-DAC02, refer to the *Quick Start Guide* that shipped with your device.

Installing the CIO-DAC02

What comes with your CIO-DAC02 shipment?

The following items are shipped with the CIO-DAC02.

Hardware

- CIO-DAC02

Additional documentation

In addition to this hardware user's guide, you should also receive the *Quick Start Guide* (available in PDF at www.mccdaq.com/PDFmanuals/DAQ-Software-Quick-Start.pdf). This booklet supplies a brief description of the software you received with your CIO-DAC02 and information regarding installation of that software. Please read this booklet completely before installing any software or hardware.

Optional components

You can also order the following MCC product to use with your CIO-DAC02.

- C25FM-x cables

- Signal termination and conditioning accessories

  MCC provides signal conditioning and termination products for use with the CIO-DAC02. Refer to Field wiring, signal termination, and conditioning on page 12 for a complete list of compatible accessory products.

Unpacking the CIO-DAC02

As with any electronic device, you should take care while handling to avoid damage from static electricity. Before removing the CIO-DAC02 from its packaging, ground yourself using a wrist strap or by simply touching the computer chassis or other grounded object to eliminate any stored static charge.

If any components are missing or damaged, notify Measurement Computing Corporation immediately by phone, fax, or e-mail:

- Phone: 508-946-5100 and follow the instructions for reaching Tech Support.
- Fax: 508-946-9500 to the attention of Tech Support
- Email: techsupport@mccdaq.com

Installing the software

Refer to the *Quick Start Guide* for instructions on installing the software on the *Measurement Computing Data Acquisition Software CD*. This booklet is available in PDF at www.mccdaq.com/PDFmanuals/DAQ-Software-Quick-Start.pdf.

Configuring the CIO-DAC02

The CIO-DAC02 has one base address switch, one wait state jumper, and one output range jumper which you must set before installing the board in your computer. The *Insta*Cal calibration and test program included with the CIO-DAC02 will show you how to set the switches. Run *Insta*Cal before you open your computer and install the board. The CIO-DAC02 is shipped with the factory-default settings listed below.

Factory-configured default settings

Board label	Switch/jumper description	Default setting
ADDRESS	DIP switch for setting the base address	300h (768 decimal)
WAIT STATE	Jumper to enable a wait state	OFF position
D/A0 D/A1	Jumpers to set the output voltage reference	External (X) position

Before installing the CIO-DAC02, verify that the board is configured with the settings that you want. Review the following information to change the default configuration of a jumper or switch on the CIO-DAC02 board.

Base address switch

Before you install the CIO-DAC02 in your computer, set the base address by using the dip switch labeled **ADDRESS** located on the board. The easiest way to set the base address switch is to let *Insta*Cal show you the correct settings. However, if are already familiar with setting ISA base addresses, you may use the base address switch description below to guide your base address selection.

Unless there is already another board in your system using address 300 hex (768 decimal), leave the switches as they are set at the factory. The example shown in Figure 2 shows the settings for the factory-default base address of 300 hex.

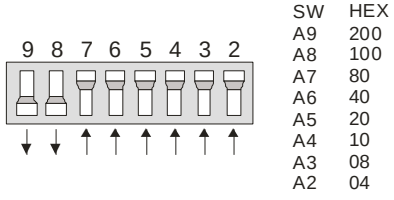

Figure 2. CIO-DAC02 base address switches

In the default configuration shown in Figure 2, addresses 9 and 8 are DOWN, and all others are UP. Address 9 = 200 hex (512 decimal) and address 8 = 100 hex (256 decimal); when added together they equal 300 hex (768 decimal).

Disregard the numbers printed on the switch

When setting the base address, refer to the numbers printed in white on the printed circuit board.

PC I/O addresses

Hex Range	Function	Hex Range	Function
000-00F	8237 DMA #1	2C0-2CF	EGA
020-021	8259 PIC#1	2D0-2DF	EGA
040-043	8253 Timer	2E0-2E7	GPIB (AT)
060-063	8255 PPI (XT)	2E8-2EF	Serial Port
060-064	8742 Controller (AT)	2F8-2FF	Serial Port
070-071	CMOS RAM & NMI mask (AT)	300-30F	Prototype card
080-08F	DMA page registers	310-31F	Prototype card
0A0-0A1	8259 PIC #2 (AT)	320-32F	Hard disk (XT)
0A0-0AF	NMI mask (XT)	378-37F	Parallel printer
0C0-0DF	8237 #2 (AT)	380-38F	SDLC
0F0-0FF	80287 numeric CO-P (AT)	3A0-3AF	SDLC
1F0-1FF	Hard disk (AT)	3B0-3BB	MDA
200-20F	Game control	3BC-3BB	Parallel printer
210-21F	Expansion unit (XT)	3C0-3CF	EGA
238-23B	Bus mouse	3D0-3DF	CGA
23C-23F	ALT bus mouse	3E8-3EF	Serial port
270-27F	Parallel printer	3F0-3F7	Floppy disk
2B0-2BF	EGA	3F8-3FF	Serial port

The CIO-DAC02 Base switch can be set for an address in the range of 000-3E0, so it should not be hard to find a free address area for your CIO-DAC02. If you are not using IBM prototyping cards, or some other board which occupies these addresses, then 300-31F HEX are free to use. Addresses not specifically listed, such as 390-39F, are free.

Wait state jumper

The CIO-DAC02 board has a wait state jumper which you can set to enable an on-board wait state generator. A wait state is an extra delay injected into the processor's clock via the bus. This delay slows down the processor when the processor addresses the CIO-DAC02 board so that signals from slow devices (chips) will be valid.

This jumper is shown in Figure 3 configured for OFF (wait state is disabled).

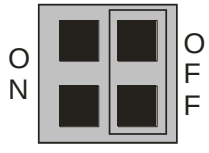

Figure 3. Wait State jumper

The wait state generator on the CIO-DAC02 is only active when the CIO-DAC02 is being accessed. Your PC will not be slowed down in general by using the wait state.

Voltage reference jumpers

The output voltage of the D/A converters is determined by the value of the reference voltage (VREF) and the digital code written to the DACs (refer to the Analog outputs section on page 13). The VREF signal must be supplied to each D/A or no voltage output will be present at the D/A's output pin. The VREF is supplied via jumpers or from an external source.

A jumper block consisting of two rows of six pins is located on the upper right corner of the board. There are two groups of pins — one for D/A 0 and one for D/A 1. Each group of pins provide a means of supplying either -5V or -10V to each D/A.

The board is shipped with both the D/A 0 and D/A 1 VREF jumpers in the external (X) position. With jumpers in the X position, the required D/A reference voltage(s) must be supplied to the 25-pin connector VREF input pins.

A -5VREF provides a ±5V output on the D/A bipolar output, 0-5V output on the unipolar output and a 4-20 mA output on the current output.

If other ranges are desired, an external voltage between -10 and +10 volts should be supplied.

The on-board voltage reference jumper supplies the same signals available at the 25-pin connector directly to the D/A VREF input, without the bother of looping the -5VREF or -10VREF outputs back into the D/A VREF inputs, as is required with the MetraByte DAC-02.

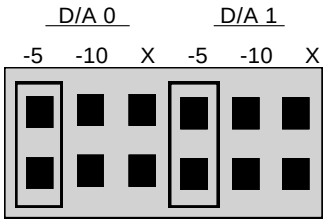

Figure 4. Voltage reference jumpers

Installing the CIO-DAC02

After you configure the board's switches and jumpers, you can install the CIO-DAC02 into your computer. To install your board, follow the steps below.

Install the MCC DAQ software before you install your board

The driver needed to run your board is installed with the MCC DAQ software. Therefore, you need to install the MCC DAQ software before you install your board. Refer to the *Quick Start Guide* for instructions on installing the software.

1. Turn your computer off, open it up, and insert your board into an available ISA slot.
2. Close your computer and turn it on.
3. To test your installation and configure your board, run the *Insta*Cal utility you installed in the previous section. Refer to the *Quick Start Guide* that came with your board www.mccdaq.com/PDFmanuals/DAQ-Software-Quick-Start.pdf for information on how to initially set up and load *Insta*Cal.

Connecting the board for I/O operations

Connectors, cables – main I/O connector

The table below lists the board connector, applicable cables, and compatible accessory products.

Board connector, cables, and accessory equipment

Connector type	25-pin D type connector
Compatible cables	▪ C25FM-x ▪ DMCON-25 (D-connector, D-shell, and termination pins to construct your own cable)
Compatible accessory products with the C25FM-x cable	CIO-MINI25

Information on signal connections

General information regarding signal connection and configuration is available in the *Guide to Signal Connections* (available at www.mccdaq.com/signals/signals.pdf).

Pinout – main I/O connector

The CIO-DAC02 I/O connector is a standard 25-pin male D connector that is accessible through the expansion backplate.

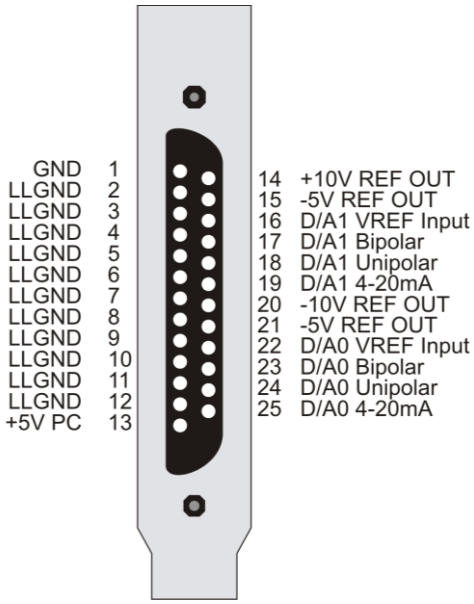

Figure 5. I/O connector pin-out

Field wiring, signal termination, and conditioning

You can use the following cabling, screw termination, and signal conditioning products with the CIO-DAC02.

- CIO-MINI25 – 25-pin screw terminal board.
- DMCON-25 – Connector kit that includes a 25-pin male D-connector, D-shell, 25 crimp pins, and cable termination kit to construct your own cable.

Details on these products are available on our web site at www.mccdaq.com/products/screw_terminal_bnc.aspx.

Functional Details

Analog outputs

Each D/A converter has three analog outputs; a unipolar voltage, a bipolar voltage and a 4-20 mA current output. The range of the output is determined by the reference voltage selected on that D/A's VREF input. The CIO-DAC02 provides two on-board jumper selectable reference voltages; -5V and -10V.

Choosing a VREF input of -5V provides a range of 0 to +5 volts on the unipolar output and ±5V on the bipolar output. The 4-20 mA output is also available at this setting.

Choosing a VREF input of -10V provides a unipolar output of 0 to +10 volts and a ±10V bipolar output.

Choosing an external voltage reference will provide:

- A unipolar output equal to: VREF/4096 * (D/A value) * (-1)
- A bipolar output equal to: VREF/2048 * ((D/A value) -2048)

4-20 mA outputs

In addition to voltage outputs, each D/A can supply a 4-20 mA output with a resolution of 0.0039 mA per bit. You can use the 4-20 mA outputs to control devices in a 4-20 mA control loop. The 4-20 mA current loop circuit is a precision current sink employing a VMOS FET. A diode provides reverse hookup protection (see Figure 6).

Select the on-board -5V reference for 4-20 mA use (see Figure 4 on page 11).

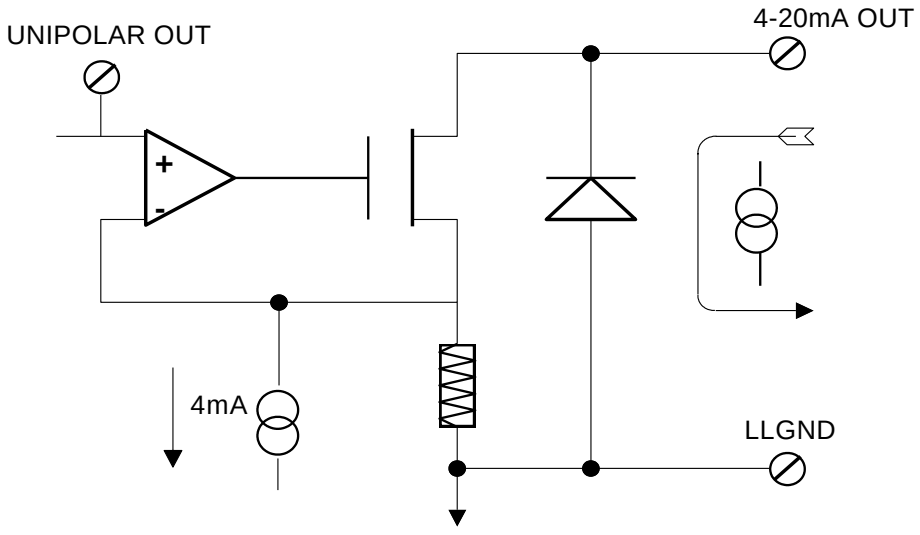

Figure 6. 4-20 mA loop output – simplified circuit diagram

A minimum of 8 VDC and a maximum of 36 VDC external excitation voltage is used to power the loop. A typical application would use a 24 V loop supply. The loop may use either a grounded load (the supply "floats"), or a grounded supply, (the load "floats"). Both methods are shown in Figure 7.

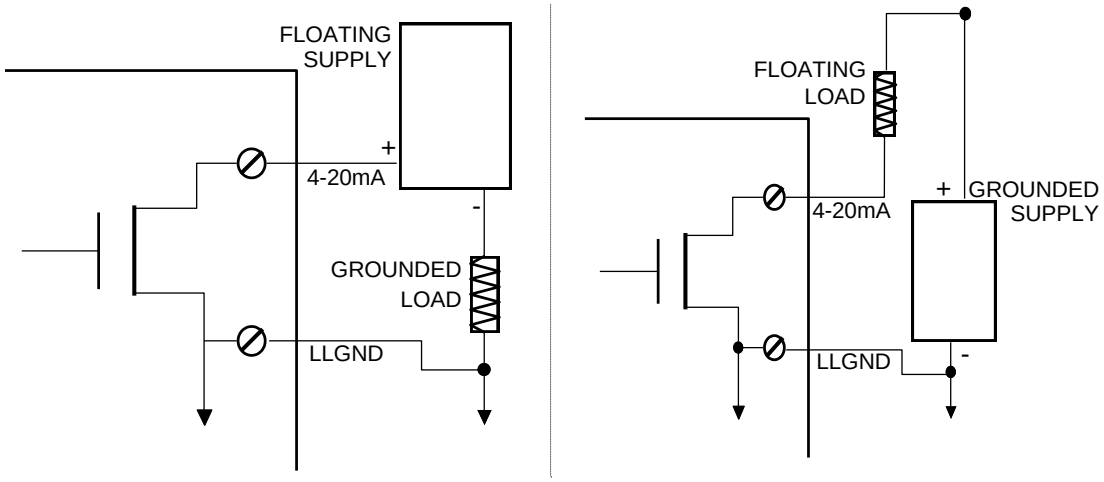

Figure 7. Loop grounding methods

Specifications

All specifications are subject to change without notice.

Typical for 25 °C unless otherwise specified.

Specifications in *italic* text are guaranteed by design.

Analog output

Table 1. Analog input specifications

D/A converter	AD7548
Resolution	*12-bits*
Number of channels	*2 voltage or current output*
Voltage ranges (Bipolar output)	±5 V, ±10 V and user range (determined by value of external reference between -10 V and +10 V) jumper selectable
Voltage ranges (Unipolar output)	0 to 5 V, 0 to 10 V and user range (determined by the value of the external reference between -10 V and +10 V) jumper selectable
Current ranges (Current output)	4 to 20 mA (using on-board or external -5 V reference)
D/A pacing	Software paced
Offset error	Adjustable to zero
Gain error	Adjustable to zero
Differential nonlinearity	±0.5 LSB max
Integral nonlinearity	±0.5 LSB max
Relative accuracy	±0.5 LSB (0.01%) max
Monotonicity	*Guaranteed monotonic to 12 bits over temperature*
Gain drift (internal referece)	±25 ppm/°C max
Offset drift	±3 ppm/°C max
Slew rate	0.3 V/µs typical
Current drive (voltage outputs)	*±5 mA min*
Voltage compliance (current out)	8 to 36 V
Output resistance (OP-07)	*0.1 ohm max*
Output short-circuit duration	*40 mA min continuous*
Miscellaneous	▪ Double buffered output latches ▪ 7 kOhm min reference input resistance

Power consumption

Table 2. Power consumption specifications

Parameter	Conditions	Specification
Supply current	+5 V supply	135 mA typ, 300 mA max
	+12 V supply	15 mA typ, 25 mA max
	-12 V supply	25 mA typ, 35 mA max

Environmental

Table 3. Environmental specifications

Operating temperature range	*0 to 70 °C*
Storage temperature range	*-55 to 125 °C*
Humidity	*0 to 90% non-condensing*

Main connector and pin out

Table 4. Connector specifications

Connector type	25-pin "D" connector
Compatible cables	C25FM-x DMCON-25 (D-connector, D-shell, and termination pins to construct your own cable)
Compatible accessory product with the C25FM-x cable	CIO-MINI25

Table 5. Connector pin out

Pin	Signal Name	Pin	Signal Name
1	GND	14	-10V REF OUT
2	LLGND	15	-5V REF OUT
3	LLGND	16	D/A1 VREF Input
4	LLGND	17	D/A1 Bipolar
5	LLGND	18	D/A1 Unipolar
6	LLGND	19	D/A1 4-20 mA
7	LLGND	20	-10V REF OUT
8	LLGND	21	-5V REF OUT
9	LLGND	22	D/A0 VREF Input
10	LLGND	23	D/A0 Bipolar
11	LLGND	24	D/A0 Unipolar
12	LLGND	25	D/A0 4-20 mA
13	+5V PC		

CE Declaration of Conformity

Manufacturer: Measurement Computing Corporation
Address: 10 Commerce Way
Suite 1008
Norton, MA 02766
USA

Category: Electrical equipment for measurement, control and laboratory use.

Measurement Computing Corporation declares under sole responsibility that the product

CIO-DAC02

to which this declaration relates is in conformity with the relevant provisions of the following standards or other documents:

EU EMC Directive 89/336/EEC: Electromagnetic Compatibility, EN55022 (1987), EN50082-1

Emissions: Group 1, Class B

- EN55022 (1987): Radiated and Conducted emissions.

Immunity: EN50082-1

- IEC 801-2 (1987): Electrostatic Discharge immunity, Criteria B.
- IEC 801-3 (1984): Radiated Electromagnetic Field immunity Criteria A.
- IEC 801-4 (1988): Electric Fast Transient Burst immunity Criteria B.

Declaration of Conformity based on tests conducted by Chomerics Test Services, Woburn, MA 01801, USA in December, 1995. Test records are outlined in Chomerics Test Report #EMI0168B.95.

We hereby declare that the equipment specified conforms to the above Directives and Standards.

Carl Haapaoja, Director of Quality Assurance

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