Model PCA3
Multichannel Analyzer

User's Manual

9231563B 9/00

ISO 9001
SYSTEM
CERTIFIED

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The information in this manual describes the product as accurately as possible, but is subject to change without notice.

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1. Introduction

The PCA3 MCA meets the need for a cost effective, mid-performance, general purpose Multichannel Analyzer. Packaged in a plug-in PC board, the PCA3 is available in three versions – 8K and 2K units with internal ADC and a 16K version for use with an external Canberra ADC. Multiple input applications can be addressed by installing multiple PCA3 boards (maximum, eight) into a single computer.

The PCA3 is suitable for use with a wide range of radiation detectors. Selecting a proper preamplifier, amplifier and high voltage power supply, makes the PCA3 compatible with NaI(Tl), HPGe, SiLi, CdTe, Ion Implanted, Plastic scintillation, BGO and other detector technologies.

A two point digital stabilizer is included to ensure system stability under a range of count rates and temperature variations. Gain and zero stabilization are independently controlled to lock on high and low energy peaks (respectively) in the spectrum. Separate ranges for HPGe and NaI detectors ensure that stabilizer will operate correctly with either detector type.

For added flexibility, the PCA3 supports both pulse height analysis (PHA) and multichannel scaling (MCS) modes of operation. In MCS mode, a single channel analyzer (SCA) output is enabled as well as a SYNC input that allows acquisition to be synchronized by external apparatus. Input rates of up to 10 MHz are supported.

Model PCA3-EX External ADC Version

For applications requiring “no compromises” performance in terms of count rate, resolution and temperature stability, the PCA3 can be paired with a Model 2060 Digital Signal Processor (DSP). For applications where requirements are not as stringent – but where high performance ADCs are still desirable, choose the Model 8701 Wilkinson ADC or the high speed Models 8713 or 8715 fixed dead time ADCs.

Models PCA3-8K and PCA3-2K Internal ADC Versions

Where the convenience of an internal ADC is preferred, the PCA3 can be obtained in versions with an integral 8K or 2K ADC. The internal ADC is a fully buffered Wilkinson Type with 100 MHz clock speed. Conversion gain can be set to 2K, 1K, 512 or 256 channels for either unit, plus 4K or 8K for the PCA3-8K unit.

Software Support

The PCA3 is fully supported by Canberra's trend setting Genie-2000 software product family. Genie-2000 supports a wide range of time proven spectral analysis algorithms, modern spectrum display and user interface as well as a variety of special applications programs. Genie-2000 software solutions are available for applications ranging as widely as laboratory gamma and alpha spectroscopy, waste measurement, whole body counting and nuclear safeguards.

2. Setup and Configuration

Unpacking

Unpack your PCA3 MCA board carefully and examine it carefully for evidence of damage caused in transit. If damage is found notify Canberra and the carrier immediately.

Remove the small insulator installed between the battery and the battery contact. See Figure 1.

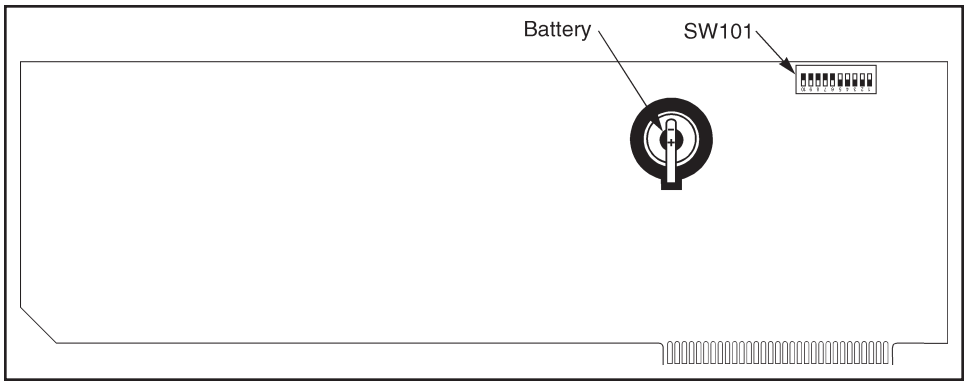


Figure 1 PCA3 Board Layout

Installation

Before installation read “Setting the I/O Address” on page 19, so that the address switches may be changed, if necessary, before the card is physically installed in the computer. The PCA3 may be installed in the target PC by using the following procedure:

1. Turn OFF the power to the computer to prevent damage to the computer and the PCA3 card.

2. Remove the cover from the computer. Consult the reference manual supplied with the computer for proper instructions on removing the cover.

3. The PCA3 may be inserted into any available ISA slot. Remove the retaining screw and lift out the blank panel from the chosen slot.

4. To insert the PCA3 card, the panel end of the card must be tilted downward as the card is inserted into the computer. When the BNC connector has cleared the rear-panel cutout, the rear of the board may be rotated downward until the card is parallel to and centered above the card edge connector. Use moderate downward pressure to seat the PCA3 card in the edge connector.

5. Replace the panel retaining screw in the PCA3 card panel and tighten.

6. Replace the computer cover by reversing the procedure in step 2.

7. Reapply power to the computer and boot the operating system software.

8. Install the Genie-2000 Basic Spectroscopy software according to supplied Genie-2000 software manuals.

9. Refer to “Creating an MCA Input Definition” on page 4 for complete operating instructions.

Creating an MCA Input Definition

After you have installed the Genie-2000 software, the first step in using your PCA3 MCA board is to create an MCA Input Definition (MID).

MID Wizard or MID Editor?

For most cases, you’ll use the MID Wizard to help you set up your Input Definition quickly and easily.

If your Input Definition is more complex than the MID Wizard was designed to handle (i.e. multiple PCA3 boards or other MCAs within a single PC), you’ll use the MID Editor (page 7) to create or change your definition.

The MID Wizard

To use the MID Wizard, open the Genie-2000 folder and select the MID Wizard icon to start the definition process.

Step 1

The first screen (Figure 2) lets you select the MCA you want to create a definition for. Select the corresponding PCA3 model from the list of MCAs (2K board, 8K board or external ADC version).

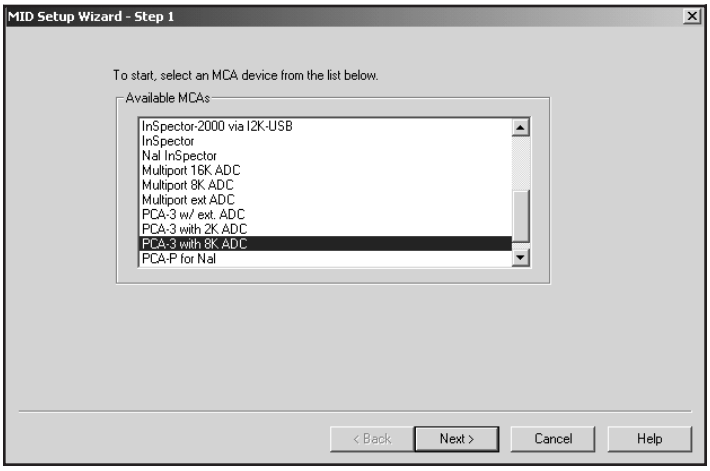


Figure 2 Selecting the MCA

Step 2

The setup screen will ask you to define the MCA board's I/O Address as shown in Figure 3. By default, the PCA3 has an I/O address of 0210 (hex). See"Setting the I/O Address" on page 19 for instructions on changing the address. The I/O Address defined by the setting of switch SW101 must match the address defined in the MID.

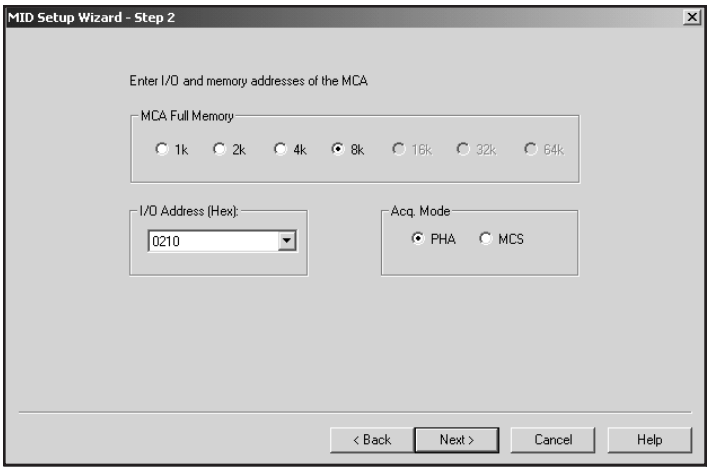


Figure 3 Defining the I/O Address

Steps 3 through 5

You won't see the screens for Steps 3 through 5; these steps are not used when setting up a PCA3.

Step 6

The Step 6 screen in Figure 4 asks for a Detector Type and acquisition input size (in channels), and requires that an Input Name be entered. Select the desired input size, based on your application's needs and the availability of spectral memory (up to 2K for PCA3-2K, up to 8K for PCA3-8K and up to 16K for PCA-EX).

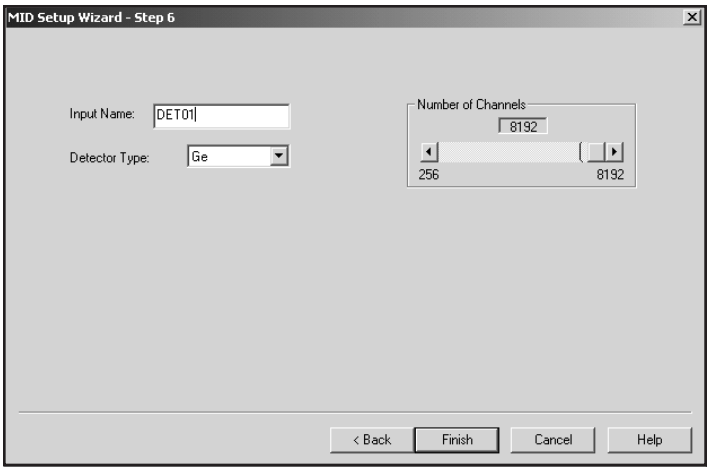


Figure 4 Assign the Detector Type

Ending the Definition

To complete your Input Definition, select **Finish**. The input that you just defined will be stored as an MID file named inputname.MID and automatically loaded into the Genie-2000's MCA Runtime Configuration Database (described in "Using MCA Definition Tables" in Chapter 3, MCA Input Definition of the *Genie-2000 Operations Manual*). When you select **Finish**, you will be asked if you would like to define another input. Answering No will close the Wizard.

Note that if you didn't enter an Input Name, you won't be allowed to exit the Step 6 screen. If the name you entered is the same as the name of an existing MID file, the system will tell you so and go back to Step 6 to let you enter another name.

The MCA Input Definition Editor

Most users will not need to use the MCA Input Definition (MID) Editor. The MID Editor allows you to create, edit and manage input definitions. However, for most users, the facilities provided in the MID Wizard are sufficient. You'll have to use the MID Editor only if you want to change any of the parameters listed below from their default values:

- **Dwell Time** for MCS mode. Note that this parameter is also adjustable within the Gamma Acquisition and Analysis application.
- Coincidence Mode and Dead Time Mode for the Models PCA3-2K and PCA3-8K with internal ADC.
- Multiple **Memory Groups** are selectable only from within the MID Editor.

The editing procedure is described in "Editing an MCA Definition" in the MCA Input Definition chapter of the *Genie-2000 Operations Manual*. That chapter also has detailed information on using the MID Editor.

The MCA Adjust Screens

The MCA Adjust Screens, which are accessed from the Gamma Acquisition and Analysis application's Menu Bar, allow you to adjust the PCA3's programmable controls.

You may access the MCA Adjust screens after having defined an MCA Input Definition (MID) as instructed above: Start the "Gamma Acquisition and Analysis" program contained in the Genie-2000 folder, open your detector (datasource) you just have defined and use the **MCA | Adjust** menu option.

As adjustments are made in the dialog box, the new values are sent to the PCA3. To save the adjustments to the datasource's CAM file, use the Gamma Acquisition and Analysis application's **File | Save** command so that the next time this datasource is selected, the proper setting will be loaded into the PCA3.

The **Next** and **Prev**(ious) buttons at the left side of the Adjust screen are used to move to the next (or previous) page of the controls when there are more control elements than will fit in the basic box.

To access the Adjust screens, a PCA3 datasource must have been opened. To open, select **File | Open Datasource**, then select "Detector" in the Type box. Next, select the datasource file and click on open.

Note: If you get a "Required Hardware Unavailable" error, possible causes are: selecting the wrong datasource for the instrument, an I/O address mismatch (see instructions above) or an I/O address conflict (means that the selected I/O address is already in use by some other device within your PC). In case of an I/O address conflict use the I/O address switch (SW101) to set your PCA3's address to another (free) one.

If you get a "Hardware Verification Error" there is a mismatch between the MID Definition setup and the hardware configuration. You can choose to accept or not accept the verification error in the associated dialog box. If you select NO, a RED error box will appear in the top left corner of the Gamma Acquisition and Analysis window. To determine the source of the verification error, open the Status Page by clicking **MCA | Status** in the Acquisition and Analysis window. The problematic item will be marked with an asterisk (*).

Each of the following sections describes one of the PCA3 parameters that can be changed in the Gamma Acquisition and Analysis (GAA) application Adjust dialog. To change a parameter, click on **MCA | Adjust** in the GAA application's Main Menu, then select the radio button for the parameter you want to change.

Stabilizer Parameters

(PCA3-2K and PCA3-8K only)

The Stabilizer settings screen (Figure 5) for the PCA3 contains the following controls.

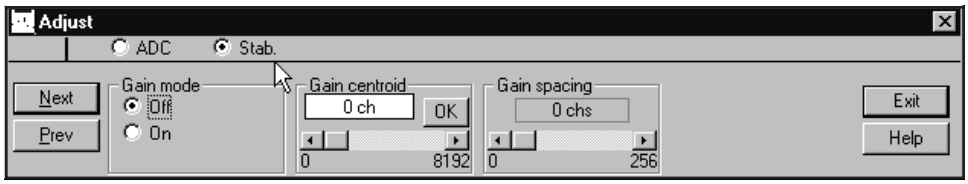


Figure 5 Adjust Screen Stabilizer Settings

Note: Zero controls (Zero Mode, Zero Centriod, and Zero Spacing) are on the second page of controls.

Figure 6 shows the relationship between the Stabilizer's Centroid and Spacing on a typical peak, for both Zero Stabilization and Gain Stabilization. See "Stabilizer" in Chapter 4, Gamma Acquisition and Analysis, of the *Genie-2000 Operations Manual* for a detailed explanation of how a Stabilizer is used.

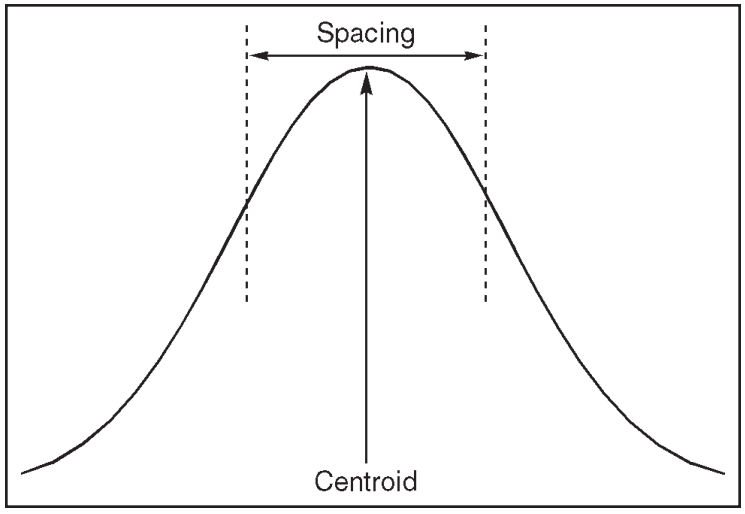


Figure 6 Relationship Between Stabilizer Functions

Gain Centroid

Sets the centroid (in channels) of the reference peak at the high end of the spectrum for gain stabilization.

Zero Centroid

Sets the centroid (in channels) of the reference peak at the low end of the spectrum for zero stabilization.

Gain or Zero Spacing

Sets the spacing (in channels) between the upper and lower sampling channels. The sampling channels should be placed so that a shift in the reference peak reflects a significant change in count rate in the sampling channels. For broad peaks, the spacing should be set so that the sampling channels are not on the flat part of the peak.

Gain or Zero Mode

Sets the Stabilization mode to Off, which disables the (Gain or Zero) Stabilizer, or On, which enables the Stabilizer.

MCS Parameters

The MCS settings screen (Figure 7) for the PCA3 contains the following controls.



Figure 7 Adjust Screen MCS Settings

Note: The MCS Adjust Screen and the associated selection button are available only if MCS was selected as the Acquisition Mode when setting up the MCA controls in the **Devices | MCA** screen of the MID Editor. If MCS was not selected the selection button and adjust screen are hidden from view.

Dwell Time

Sets the MCS dwell time value.

ADC

The ADC setting screen (Figure 8) for the PCA3 contains the following controls. This feature is available only for Models PCA3-2K and PCA3- 8K.

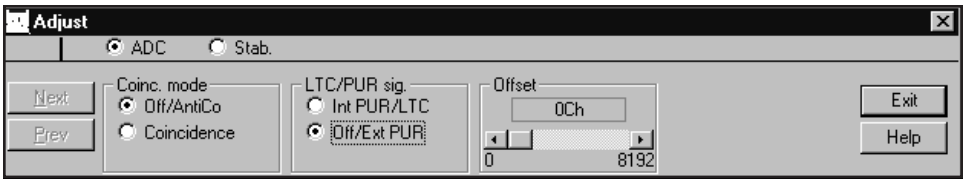


Figure 8 Adjust Screen ADC Settings

Coincidence Mode

Sets the coincidence mode for the external Gate signal, when external gating is used.

LTC PUR sig

Int PUR/LTC – Enables the PCA3 internal live time correction and pile up rejection circuitry.

Off/Ext PUR – Disables the live time correction and pile up circuitry of the PCA3. Expects a live time (dead time) signal from an external source via the BSY/DWL input.

Offset

Sets the ADC's digital offset, in channels.

Acquire Setup Screen

The Gamma Acquisition and Analysis application's Acquire Setup Screen is described in detail in the *Genie-2000 Operations Manual*. However, the External Start option on this screen is of particular significance at this time.

Checking External Start enables the PCA3's External Sync function, which works in conjunction with the EXTSY signal at the rear panel I/O port. In PHA mode, a positive TTL level enables data acquisition and the Real Time and Live Time clocks. In MCS mode, a positive TTL pulse starts/restarts a sweep.

A. Specifications

Note: For a more detailed description of Input and Output Connectors refer to Appendix B, *Rear Panel Connector Pinouts*.

Board Configuration

Full length ISA compatible plug-in card.

Processor

Intel 80C188; 10 MHz clock.

ROM – 128K x 8.

RAM – 64K x 8 data RAM, 32K x 8 processor RAM.

Inputs

LOGIC SIGNALS – Rear-panel DB-9 connector.

GATE – TTL; Coincidence or Anticoincidence.

REJECT – Positive TTL; Pileup reject.

BUSY – Positive TTL; External busy.

SYNC – Positive TTL; Enable acquisition.

Outputs

LOGIC SIGNALS – Rear panel DB-9 connector.

BUSY – Positive TTL.

ROI – Width and amplitude; adjustable pulse.

SCA – Positive TTL pulse.

CH-SMPL – Positive TTL pulse.

Data Acquisition

CHANNELS – 16 384; configurable as one 16K channel group, two 8K channel groups (PCA3 with external ADC only), four 4K channel groups, eight 2K groups, sixteen 1K groups, thirty-two 512 channel groups, or sixty-four 256 channel groups.

ADC

CONNECTOR – Rear panel BNC.

CONVERSION RATE – Fully buffered 2K/8K channel Wilkinson ADC with 100 MHz clock.

CONVERSION GAIN – 8K, 4K, 2K, 1K, 512, 256; computer selectable.

RANGE – From 0 to 10 V, unipolar or bipolar, positive lobe leading.

RISETIME – 0.5 μs to 30 μs.

INTEGRAL NONLINEARITY – ≤±0.05% over top 99% of range.

DIFFERENTIAL NONLINEARITY – ≤±1% over top 99% of range.

GAIN DRIFT – ≤±100 ppm/°C.

ZERO DRIFT – ≤±50 ppm/°C of full scale.

DIGITAL OFFSET – Selectable in 256-channel blocks from 256 to 7936.

Live Time Clock

RESOLUTION – 10 ms; type: LTC.

Presets

REAL TIME – 1 to 9 999 999 seconds.

LIVE TIME – 1 to 9 999 999 seconds.

SCA

15-turn rear panel potentiometers:

ZERO – Adjustable.

LLD – <1% to 105% of full scale.

ULD – 0% to 105% of full scale.

Digital Stabilizer

Internal zero and gain stabilization.

HPGe – Range: ±3.1%, nominal; Resolution: 0.0125 channel, nominal, at 8192 channels.

NaI – Range: ±12.5%, nominal; Resolution: ±0.25% channel, nominal.

External ADC

INTERFACE – TTL interface cable; rear panel DB-37 connector.

Multichannel Scaling (MCS)

INPUT RATE – Up to 10 MHz.

DWELL TIME – Internal 10 µs to 100 s; external 10 µs, minimum.

SYNC – Internal or External.

DEAD TIME – 2 µs between passes, 2 µs between channels.

PRESET – 1 to 9 999 999 passes.

MCS INPUT – Positive TTL; rear panel DB-37 connector.

LOGIC INPUTS – DWL, positive TTL; SYNC positive TTL; rear-panel DB-9 connector.

LOGIC OUTPUT – MSB positive TTL; rear-panel DB-9 connector.

Environmental

OPERATING TEMPERATURE – 0 to 50 °C.

OPERATING HUMIDITY – 0-80% relative, non-condensing.

Ordering Information

PCA3-EX – PCA3 Board with External ADC.

PCA3-2K – PCA3 Board 2K.

PCA3-8K – PCA3 Board 8K.

Requires Genie-2000 Basic Spectroscopy Software (S502C or S500C, sold seperately).

B. Rear Panel Connector Pinouts

I/O Connector

Pin	Signal	Description
1	BSY/DWL	For PHA : External busy correction; Positive TTL input;
		For MCS: External dwell advance; Positive TTL input; duration <30 ns; interval >10 μs; latency <2 μsec; deadtime <2 μs between channels.
2	GATE	Coincidence or Anti-Coincidence; TTL input pulse; must occur ≥100 ns before peak and remain >30 ns after peak.
3	MCS/REJ	For PHA : Pile up reject; Positive TTL input; Latched if true after input pulse crosses input discriminator and before peak detect. Evaluated at peak detect; Must be >50 ns after input crosses input discriminator, <100 ns before peak detect, duration >30 ns.
		For MCS: MCS data; Positive TTL input pulse; <10 MHz; duration >30 ns.
4	EXTSY	Enable acquisition signal; Positive TTL input; Internally pulled high.
5	GND	Ground
6	SCA	Single channel analyzer; Positive TTL input; Internally pulled high.
7	MSB/BSY	Single channel analyzer; Positive TTL output pulse; ~200 ns width.
		For PHA : Busy indication; PositiveTTL output; Normal Deadtime mode: The OR of the input discrimator, ADC busy, and External BSY input. External Deadtime mode: Uses BSY input only for dead time control.
		For MCS: Most Significant Bit or MCS address; Positive TTL output.
8	CHSMPL	Sample changer advance; Positive TTL output.
9	ROI	Event Storage indicator; Positive TTL output; adjustable width (4 to 35 μs).

External ADC Interface

The PCA3 External ADC Interface is designed to interface the PCA3 to external, stand-alone NIM-type ADCs, offered by Canberra. The External ADC Interface supports up to a 14-bit (16,384-channel) ADC, with a 24-bit deep histogram data memory. The External ADC Interface is accomplished through the DB37S Rear-Panel connector.

Many of the features available for the Internal ADC are also available for the External ADC, such as group control. However, conversion gains, offsets and DSS are not available when an external ADC is in use.

To verify that the External ADC Interface is installed properly, ensure that the 40-pin insulation-displacement connector, attached to the flat ribbon cable from the DB37S Rear-Panel connector, is installed on CN302A. Install a C1704-10 interface cable from the rear of the computer to the External ADC.

External ADC Connector

Pin	I/O	Signal	Comments
26	I	ADC0	DATA signals from ADC
27	I	ADC1	3.3 kΩ to +5V
28	I	ADC2	
29	I	ADC3	
30	I	ADC4	
31	I	ADC5	
32	I	ADC6	
8	I	ADC7	
9	I	ADC8	
10	I	ADC9	
11	I	ADC10	
12	I	ADC11	
13	I	ADC12	
7	I	ADC13	
24	I	ADCRDY	READY signal from ADC. 3.3 kΩ to +5V Data ready for storage

25	I	ADCINV	INVALID signal from ADC 3.3 kΩ to +5V Prevents storage of data
22	I	ADCDT	BUSY signal from ADC 3.3 kΩ to +5V Stops Live Time Clock
23	O	ADCACQ	ENABLE signal to ADC}
21	O	ADCTX	TRANSMIT signal to ADC. Enables ADC output buffers for data transfer
20	O	ADCACK	ACKNOWLEDGE signal to ADC. Clears ADC to continue
1-6	-	GND	

C. Setting the I/O Address

The PCA3 card is shipped from the factory with the most common settings for the address switches set by SW101, a ten-position DIP switch located at the top of the PCA3 card near the rear-panel bracket, see Figure 1 on page 3. Optional address switch settings may be made with the following procedure.

When one of the SW101 switches is in the OPEN position, the logic level is '1'. When the switch is CLOSED, the logic level is '0'. The seven switches, numbered 4–10, select the base I/O port address for the PCA3 card. The PCA3 card is shipped with SW101 switches 5 and 10 in the OPEN position and all other switches in the closed position. This setting is for a base I/O port address of 528_{10} (210_{H}).

If there is a conflict with another function in the PC at this I/O address, another address may be selected. The PCA3 card SW101 switches 4 –10 allow base I/O port address selection in the range from 100_{H} through $3F8_{H}$.

Note: When the address switches are changed, the Genie-2000 software must be configured to the new port address.

The table on the following pages lists the switch settings for all of the board's I/O addresses.

Note: SW101-1, SW101-2 and SW101-3 must be set to CLOSED (or ON) all the time.

A logic 1 in Table 1 means that the corresponding switch must be set to OPEN (or OFF).

A logic 0 in Table 1 means that the corresponding switch must be set to CLOSED (or ON).

PCA3 I/O Address Settings							
MCA board I/O address	SW101-4	SW101-5	SW101-6	SW101-7	SW101-8	SW101-9	SW101-10
100	0	0	0	0	0	1	0
108	1	0	0	0	0	1	0
110	0	1	0	0	0	1	0
118	1	1	0	0	0	1	0
120	0	0	1	0	0	1	0
128	1	0	1	0	0	1	0
130	0	1	1	0	0	1	0
138	1	1	1	0	0	1	0
140	0	0	0	1	0	1	0
148	1	0	0	1	0	1	0
150	0	1	0	1	0	1	0
158	1	1	0	1	0	1	0
160	0	0	1	1	0	1	0
168	1	0	1	1	0	1	0
170	0	1	1	1	0	1	0
178	1	1	1	1	0	1	0
180	0	0	0	0	1	1	0
188	1	0	0	0	1	1	0
190	0	1	0	0	1	1	0
198	1	1	0	0	1	1	0
1A0	0	0	1	0	1	1	0
1A8	1	0	1	0	1	1	0
1B0	0	1	1	0	1	1	0
1B8	1	1	1	0	1	1	0
1C0	0	0	0	1	1	1	0
1C8	1	0	0	1	1	1	0
1D0	0	1	0	1	1	1	0
1D8	1	1	0	1	1	1	0
1E0	0	0	1	1	1	1	0
1E8	1	0	1	1	1	1	0
1F0	0	1	1	1	1	1	0
1F8	1	1	1	1	1	1	0
200	0	0	0	0	0	0	1
208	1	0	0	0	0	0	1

PCA3 I/O Address Settings							
MCA board I/O address	SW101-4	SW101-5	SW101-6	SW101-7	SW101-8	SW101-9	SW101-10
210 (Factory default)	0	1	0	0	0	0	1
218	1	1	0	0	0	0	1
220	0	0	1	0	0	0	1
228	1	0	1	0	0	0	1
230	0	1	1	0	0	0	1
238	1	1	1	0	0	0	1
240	0	0	0	1	0	0	1
248	1	0	0	1	0	0	1
250	0	1	0	1	0	0	1
258	1	1	0	1	0	0	1
260	0	0	1	1	0	0	1
268	1	0	1	1	0	0	1
270	0	1	1	1	0	0	1
278	1	1	1	1	0	0	1
280	0	0	0	0	1	0	1
288	1	0	0	0	1	0	1
290	0	1	0	0	1	0	1
298	1	1	0	0	1	0	1
2A0	0	0	1	0	1	0	1
2A8	1	0	1	0	1	0	1
2B0	0	1	1	0	1	0	1
2B8	1	1	1	0	1	0	1
2C0	0	0	0	1	1	0	1
2C8	1	0	0	1	1	0	1
2D0	0	1	0	1	1	0	1
2D8	1	1	0	1	1	0	1
2E0	0	0	1	1	1	0	1
2E8	1	0	1	1	1	0	1
2F0	0	1	1	1	1	0	1
2F8	1	1	1	1	1	0	1
300	0	0	0	0	0	1	1
308	1	0	0	0	0	1	1
310	0	1	0	0	0	1	1

PCA3 I/O Address Settings							
MCA board I/O address	SW101-4	SW101-5	SW101-6	SW101-7	SW101-8	SW101-9	SW101-10
318	1	1	0	0	0	1	1
320	0	0	1	0	0	1	1
328	1	0	1	0	0	1	1
330	0	1	1	0	0	1	1
338	1	1	1	0	0	1	1
340	0	0	0	1	0	1	1
348	1	0	0	1	0	1	1
350	0	1	0	1	0	1	1
358	1	1	0	1	0	1	1
360	0	0	1	1	0	1	1
368	1	0	1	1	0	1	1
370	0	1	1	1	0	1	1
378	1	1	1	1	0	1	1
380	0	0	0	0	1	1	1
388	1	0	0	0	1	1	1
390	0	1	0	0	1	1	1
398	1	1	0	0	1	1	1
3A0	0	0	1	0	1	1	1
3A8	1	0	1	0	1	1	1
3B0	0	1	1	0	1	1	1
3B8	1	1	1	0	1	1	1
3C0	0	0	0	1	1	1	1
3C8	1	0	0	1	1	1	1
3D0	0	1	0	1	1	1	1
3D8	1	1	0	1	1	1	1
3E0	0	0	1	1	1	1	1
3E8	1	0	1	1	1	1	1
3F0	0	1	1	1	1	1	1
3F8	1	1	1	1	1	1	1

Request for Schematics

Schematics for this unit are available directly from Canberra. Write, call or FAX:

Training and Technical Services Department
Canberra Industries
800 Research Parkway, Meriden, CT 06450
Telephone: (800) 255-6370 or (203) 639-2467
FAX: (203) 235-1347

If you would like a set of schematics for this unit, please provide us with the following information.

Your Name _____

Your Address _____

_____

_____

_____

_____

Unit's model number _____

Unit's serial number _____

Note: Schematics are provided for information only; if you service or repair or try to service or repair this unit without Canberra's written permission you may void your warranty.

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If defects are discovered within 90 days of receipt of an order, we will pay for shipping costs incurred in connection with the return of the equipment. If defects are discovered after the first 90 days, all shipping, insurance and other costs shall be borne by you.

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