

VelociGraph VG03

Operation Manual

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TABLE OF CONTENTS

1. Introduction	1
2. Connections	2
a. Sensor Connections	4
b. Power connections	5
3. Configuration	6
4. Communication	7
a. Communication Settings	7
b. Recorder Software	8
5. ADC VelociGraph Recorder 1.10	8
a. Install Instructions	8
6. VG03 Protocol	10
7. Software Installation	12
8. Testing VG03 unit with software	13
9. Sensing Test Protocol	15
10. Trouble Shooting Guide	19

I. Introduction

Thank you for your purchase of the ADC VelociGraph, the most advanced high-speed chronograph available. Every effort has been made to ensure that your new VelociGraph is a high-quality, easy to use precision instrument. This Operation Manual contains instructions for setting up your VelociGraph and configuring it for your application.

Your VelociGraph might have features not described in this documentation. If your VelociGraph is marked as a custom order, please be sure to see any additional documentation included with the unit after reading through this manual.

The VelociGraph VG03 captures high-speed pulses from external sensors (typically an ADC iBeam Sensor, or other light-screen sensor), calculates the time between those pulses and, if configured to do so, the speed of the projectile that passed through the sensors. Data is available via the RS485 serial port built into the device using a custom protocol.

The VG03 is designed to be integrated easily with an ADC iBeam sensor system, but can accept any pulse 0.5 milliseconds or with a voltage range of 5-24VDC without any need for configuration. In short, the VelociGraph VG03 can be integrated with almost any sensor available.

The VG03 is typically used for capturing the speed of a projectile, but has been used for other applications, as well. Because of its adaptability and the ease at which it can be used with other software, the uses of the VG03 are limitless.

The VG03 has four inputs, but can be networked with other VG03 units to handle large sensor installations.

The VG03 operates at 80 MHz

II. Connections

Cables are available to easily and securely connect your VelociGraph to ADC iBeam sensors, and are provided with your sensors to simply install.



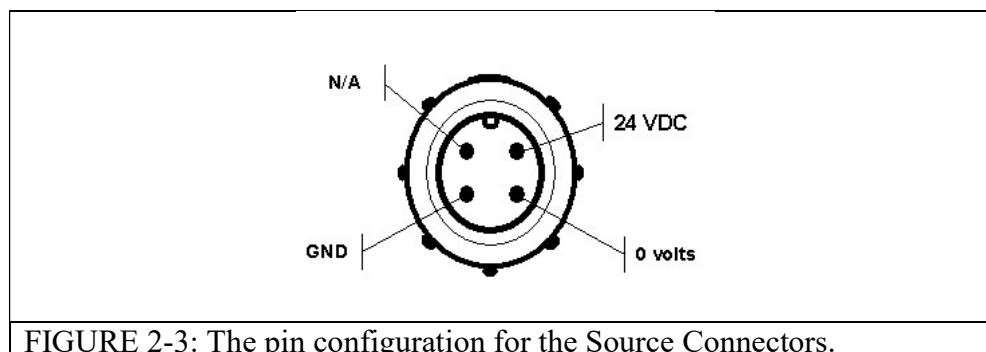
Sensor Connections:

Begin by connecting the light source, or EMITTER, for your sensors to the EMITTER CONNECTIONS ON THE VG03. Emitters can be connected in any order.

⚠ CAUTION

SOURCE CONNECTIONS PROVIDE SUPPLY POWER FOR ANY SENSOR LIGHT SOURCE (24VDC OUTPUT). BE SURE TO CONNECT THE EMITTERS TO THE PROPER PINS OF THE SOURCE CONNECTOR, AND THAT THE EMITTER CAN ACCEPT 24VDC AS THE INPUT POWER, OR DAMAGE CAN RESULT.

The SOURCE connectors have the following connections:



For iBeam sensors, simply use the cables provided and connect to the EMITTER port on your VG03. For sensors from other manufacturers, see the documentation that came with your sensor.

Next, connect the sensor RECEIVERS to the VelociGraph.

The RECEIVER connections have the following connections:

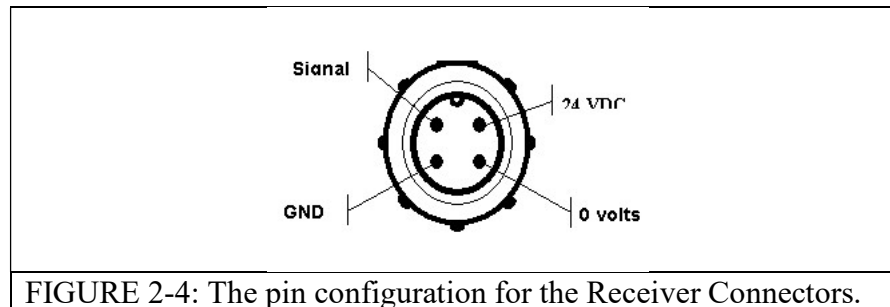


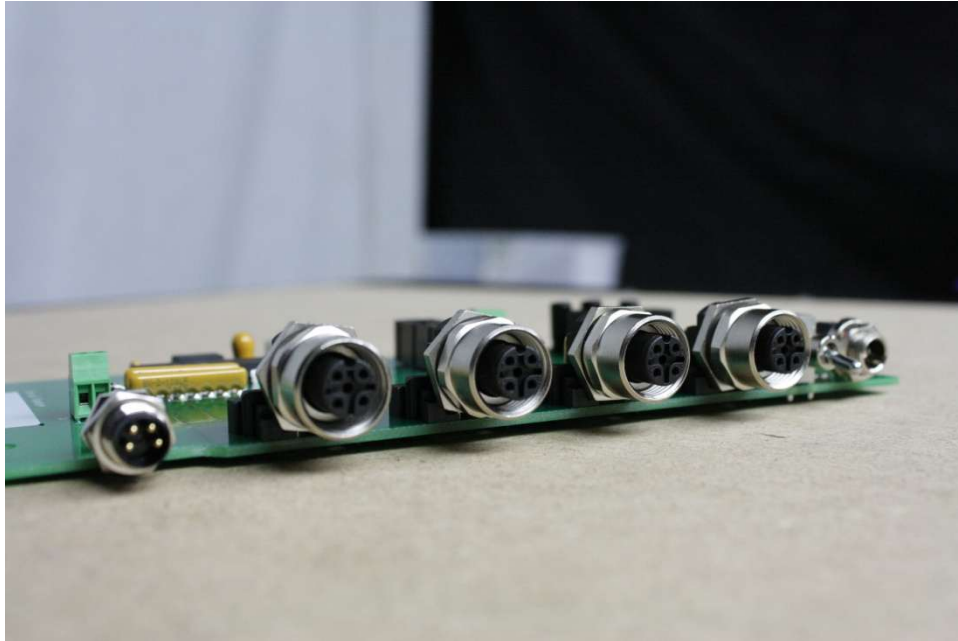
FIGURE 2-4: The pin configuration for the Receiver Connectors.

For iBeam sensors, simply use the cables provided.

The RECEIVER connections *must be connected in the order of the ball path*, where RECEIVER A is the receiver closest to the entry path of the projectile, and RECEIVER C is the final receiver in the path of flight.

Power Connections:

Connect the AC Adaptor to the +24 VDC Female plug on the back of the enclosure. Please be sure to use the AC Adaptor provided with the VelociGraph.



III. Configuration

The VelociGraph is used to capture pulses from up to 4 sensors.

The VG03 comes with a factory defaults already programmed into the unit. These defaults work for most situations.

The VelociGraph VG03 is configured using the vg03config program, which sends configuration data to the VG03 through its serial port. Vg03config is provided with the purchase of a new VG03, or freely downloaded from the Automated Design Corporation website at <http://www.automateddesign.com>.

Vg03Config computer requirements:

- OS: Microsoft Windows 7/8/10/11
- A standard R485 serial port
- An RS485 cable (provided with VG03)

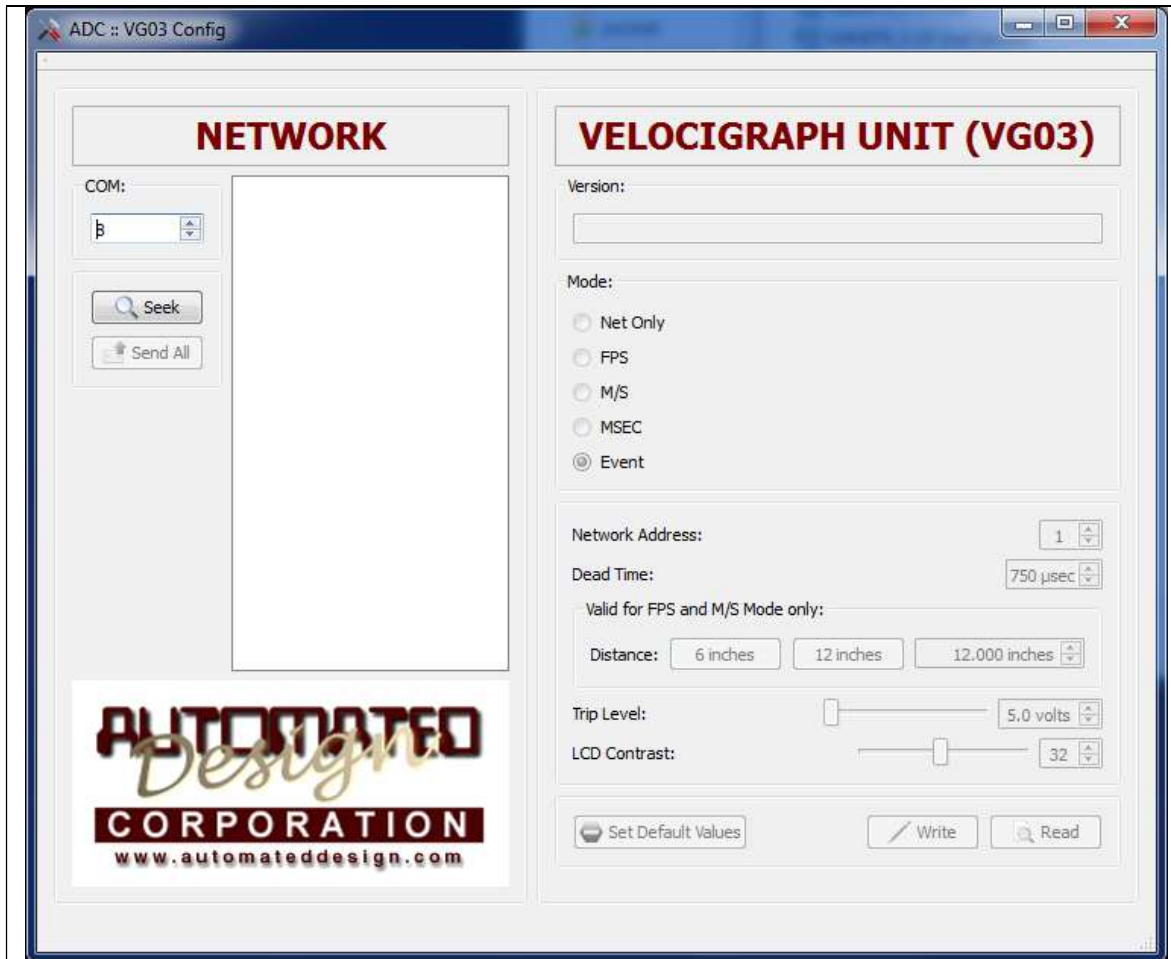


Figure 3-1: The Vg03Config software is used to configure the VG03 unit.

Note: See VIII for interface usage.

IV. Communications

The VelociGraph VG03 includes an RS485 serial port for broadcasting results real-time during operation. The results are broadcast as an ASCII text string at the end of a pulse sequence.

Depending on the model and configuration of the VG03, the following information will be broadcast:

- INBOUND VELOCITY (user units): Receiver A->C
 - OUTBOUND VELOCITY (user units): Receiver C->A
 - REBOUND TIME (ms): Time between first and second C receiver pulse
- MODEL VG03 ONLY
- INBOUND ANGLE (degrees): Angle A->B->C
 - OUTBOUND ANGLE (degrees): Angle C->B->A

OUTPUT FORMAT FOR VG03:

<INBOUND VEL><SP><OUTBOUND VEL><SP><REBOUND TIME><CR><LF>

SAMPLE OUTPUT:

160.0000 83.1344 5.2387

OUTPUT FORMAT FOR VG03

If a pulse sequence is not complete, or has any missing pulses, an error code is generated and embedded in the result string. Any calculations for which there are enough pulses available are completed. For any calculations where there are not enough pulses, the result is replaced by the receiver (A, and/or C) and the direction number (1 for INBOUND or 2 for OUTBOUND) that is missing.

This is useful for diagnostic purposes, as it allows for the operator to pinpoint any trouble sensors.

EXAMPLE OUTPUT WITH ERRORS:

160.0000 C2 ← Missed the C sensor on the rebound.

B1C1 B2C2 ← Missed the B and C sensors in both directions.

COMMUNICATION SETTINGS:

Communication settings for the VG03 are fixed at:

- Baud Rate: 9600
- Data Bits: 8
- Parity: NONE
- Stop Bits: 1
- Flow Control: NONE

RECORDER SOFTWARE

As a service to our customers, ADC provides the *Recorder* series of software free of charge to VelociGraph owners. Depending on your purchase of the VG03, a CD containing the install program may have been included with the unit. The latest version of the software is always freely available from our website at <http://www.automateddesign.com>

The Recorder software will connect to the VG03, capture data, and paste captured data real-time into Microsoft Excel (not included). This manual contains basic instructions for using Recorder with the VG03. For more details, see the available Recorder Manual.

V. ADC VelociGraph Recorder 1.10

INSTALL INSTRUCTIONS:

Recorder is freely available to all customers that have purchased the ADC VelociGraph. A CD-ROM is included with the VelociGraph containing the Recorder install program. The latest version of the software is available from the Automated Design Corporation website at <http://www.automateddesign.com/download.html>.

Recorder System Requirements:

- Microsoft Windows 9x or Greater
- At least one serial port (USB converters are NOT supported)
- CDROM Drive (for CD Install)
- Microsoft Excel (for LINK or EXPORT function)

To install from a CD-ROM:

1. Insert CD-ROM into computer.
2. Execute file (CDROM drive):\setup.exe
3. Follow onscreen instructions. Please agree to all default settings.

To install from a downloaded ZIP file:

1. Expand ZIP file to c:\adc_INST\recorder\
2. Execute file c:\adc_INST\recorder\setup.exe
3. Follow onscreen instructions. Please agree to all default settings.

STARTING RECORDER

1. From the START menu, select PROGRAMS-> ADC VelociGraph -> VelociGraph RECORDER 1.10.
2. Select the COM Port you wish to use from the drop down list. For most users, this will be COM1.
3. Click the SET PORT button. You are now connected to the VelociGraph.

RECORDING DATA

1. Click the checkbox marked RECORD DATA.
2. A message will appear asking if you would like to Record Data. Select YES.
3. All data collected by Recorder will now be logged into memory.

To STOP recording...

1. Click the RECORD DATA checkbox.
2. A message will appear asking if you would like to stop recording. Select YES.

Link to Excel

- You may link data to Excel for real-time transfer. This is especially useful if you wish to annotate results while testing.
 - You must be RECORDING DATA to LINK to Excel.
 - Microsoft Excel is not included with Recorder, nor licensed by Automated Design Corporation. Please be sure to have installed Microsoft Excel on your computer before attempting to LINK.
1. Be sure that Recorder is RECORDING DATA (see section “RECORDING DATA”).
 2. Click the LINK checkbox.
 3. A message will appear asking if you would like to Link to Microsoft Excel. Select YES.
 4. Excel will appear, loading the custom template provided with Recorder. Data will be transferred real-time to the spreadsheet. You may save the spreadsheet as you would any other in Microsoft Excel.

STOP LINK TO EXCEL

1. Click the LINK checkbox.
2. A message will appear asking if you would like to stop the LINK to Excel. Select YES.
3. A message box will appear asking if you would like to close the Microsoft Excel spreadsheet.
 - Select YES if you have saved all data and are done using the spreadsheet, or if you do not wish to save the data. Microsoft Excel will close automatically.
 - Select NO if you have not saved the data, or would like to continue to view the spreadsheet on-screen. The Link will close, but the spreadsheet will remain onscreen.
4. Please note that any open spreadsheets must be closed before attempting to LINK to Excel again.

VI. VG03 Protocol

VG-03 units can be accessed over an RS-485 network.

The line parameters are:

Baud rate:	9600
Parity:	None
Data bits:	8
Stop bits:	1

The messages from the master and those returned from the nodes all have the same format:

<AACCHaabbccddXX>

Where

- <** Is the **start** of message character, an open angle bracket character, an ASCII $3C_{hex}$

- AA** Is the **address** of the target node, encoded as two ASCII hexadecimal digits, 01_{hex} to FE_{hex} . The address 00_{hex} is reserved for the network master, and FF_{hex} is the broadcast address.

- CC** Is the **command** being sent, encoded as two ASCII hexadecimal digits. The commands include:
 - 01 read a register
 - 02 write a register
 - 03 synchronize clocks
 - 04 poll for measurements

- II** is the **index** for the command, usually indicating which register is being read or written, encoded as two ASCII hexadecimal digits.

- aa** Is the most significant octet of the data payload, encoded as two ASCII hexadecimal digits.

- bb** Is the next most significant octet of the data payload. For a 16-bit payload (register reads and writes), this is the least significant octet.

- cc** is the next most significant octet of the data payload. For a 16-bit payload, this is ignored

- dd** is the least significant octet of the data payload for 32-bit payload (polling).

- XX** is the message **checksum**, the exclusive-OR of all of the octets from the address through the data bytes, inclusive.

- >** is the **end** of message character, a close angle bracket character, an ASCII $3E_{hex}$.

The registers are:

- 00 Magic Number should be $CAFE_{hex}$. Used internally to initialize and verify the EEPROM.

01 Mode	00= net only, 01=fps, 02=m/s, 03=msec
02 Net Address	01 to FE
03 LCD Contrast	Usually near 32(20_{he}).
04 Trip Level	The input trip level in units of 26.85 millivolts.
05 Dead Time	The input dead time for debouncing, in units of 27.1 nanoseconds.
06 Distance	The spacing of the light curtains in units of 0.001 inches.

The following is an example of polling unit 2 after an event.

The master sends:

<0204000000000006>

The slave responds:

<0004100989680xx>
<00043009959D0xx>
<00043009A9250xx>
<00041009B7CB0xx>
<0004000000000xx>

This is interpreted as follows:

The first message is returned to the master (00), a poll response (04), for sensor 1 (1), a lead edge (0), at time 00989680, with checksum xx. The time is a decimal encoding of the item in units of 100 nanoseconds, so this 1.0000000 seconds from the time synchronization.

The second message is also returned to the master (00), is a poll response (04) for sensor 3 (3), a lead edge (0) at time 009959D0, or 1.0050000 seconds. This means that time from 1 to 3 was 5 milliseconds, and if the curtains are a foot apart, the speed is 200 fps.

The third message is to the master (00), a poll response (04), for sensor 3 (3), a lead edge (0) at time 009A9250, or 1.0130000 seconds. The rebound time was 8 milliseconds.

The fourth message is to the master (00), a poll message (04), for sensor 1 (1), a lead edge (0) at time 009B7CB0, or 1.0190000 seconds. The return time interval was 6 milliseconds, and the return speed was 166 fps.

The last message is to the master (00), a poll message (04), and marks the end of messages in the buffer (0).

VII. Software Installation

- VG03Config (recommended) or
- Foxterm

FoxTerm:

1. Download the latest version of FoxTerm.
<http://foxterm.net/download/>
2. Follow all on-screen prompts, accepting all defaults.
3. Locate the downloaded zip folder on your computer.
 - This zip file will appear in the form of **foxterm_X_X_X_X**
e.g. foxterm_1_5_3_0
4. Extract all files.
 - Right-click on the zip folder.
 - Select **Extract All...**
 - A file folder with the same name as the zipped-folder will appear (this folder will appear without a zipper)

VG03Config:

1. Download the latest version of VG03Config
<https://automateddesign.com/download/Vg03Config-Setup.exe>

VIII. Testing VG03 Unit with Software.

Selecting the correct COM number: (Windows 7)

- Click the **Start** Button on your computer.
- Go to **Control Panel**.
- Select **Hardware and Sound**
- Under “*Devices and Printers*”, click on “Device Manager”.

- Under “*Ports (COM & LPT)*”, there will be a COM number. This is COM number currently in use by the computer.

Foxterm:

1. Double-click on the folder **foxterm_X_X_X_X** from where you downloaded the software.
2. Double-click on the **FoxTerm** application
3. Run the application.
4. Select File, and then click **New COM Port Connection...**
5. Set Port to the proper number according to what COM# your computer is using to communicate.
6. Set “Echo Characters:” to true, click ok.

Examples to change Mode:

Type <0102010002000000> → will change to Mode 2.
 <0102010003000000> → will change to Mode 3.
 <0102010004000000> → will change to Mode 4.

Note: The VelociGraph unit needs to be turned off and back on in order for it to show the new mode on the LCD display.

VG03Config:

- Download the latest version of VG03Config.
<https://automateddesign.com/download/Vg03Config-Setup.exe>
- Follow all on-screen prompts, accepting all defaults.
- After completion, a short-cut icon will appear on the Start Menu and desktop.

Changing property values

Note: When a value is changed on the interface i.e. under the VELOCIGRAPH UNIT (VG03) panel, a warning icon will appear and the label of the value changed will turn red. This is to indicate that values have been changed on the interface itself and NOT the VelociGraph unit.

A VelociGraph unit will have the following display:

e.g.

ADC VelociGraph
Net 01 Mode 02

1. Select a VelociGraph from the tree-view list under the NETWORK panel.
 - Its properties will be displayed under the VELOCIGRAPH UNIT (VG03) panel.
2. Make the necessary changes, if any. When finished click the **Write** button.
 - If an error has occurred, an error message will appear.

Reading property values

1. Select a VelociGraph from the tree-view list under the NETWORK panel.
 - Its properties will be displayed under the VELOCIGRAPH UNIT (VG03) panel.
2. Click **Read**, this will populate the VG03's properties under the VELOCIGRAPH UNIT (VG03) panel.

Default Values:

*Note: Clicking the **Set Default Values** button will set the default values on the interface alone.*

1. If the default values are desired, click the **Write** button.

Test Protocol

The following items will be necessary for this test protocol.

- ADC VelociGraph VG03-400 unit (1)
- ADC 1815CAB2 cables (4-8)
- RS485 serial port programming cable (1)
- Additional computer (recommended)
- M12 Splitters if necessary (1-4)
- AC Adaptor provided with VG03 (1)

Step 1 – Software Downloads

VG03Config

The VelociGraph VG03 captures high-speed pulses from external sensors (typically an ADC iBeam Sensor, or other light-screen sensor), calculates the time between those pulses and, if configured to do so, calculate the speed and the angle of the projectile that passes through the sensors. The VG03 has 4 inputs for sensor installation. Data is available via the RS485 serial port built into the device using a custom protocol. Refer to *VG03_OperationManual.pdf* for more details. You will need the programming cable part# ADC-2325-422

Download the latest version of the VG03Config software. This software can be found at our website <https://automateddesign.com/download/Vg03Config-Setup.exe>. Also, download the VG03 Operation Manual for instructions on how to use this program.

Recorder 5.00

Download the latest version of Recorder 5.00. This software can be found at our website <https://automateddesign.com/download/Recorder-Setup.exe>

Foxterm (Optional Non-ADC software)

Download the latest version of Foxterm. This software can be found at: <http://www.foxterm.net/download/>

- a. Extract all files.
- b. The software used for trouble shooting is *FoxTerm.exe*

Step 2 – Connections

You will need to proper cable to go from the sensors to the VG03. If you do not currently use the VG03 in your everyday setup, you will need to get 1 cable per each emitter and receiver part# 1815-CAB2

Do you have more than 2 set of sensors? If so, you will need an M12 splitter as the one shown here for connecting all the sensors to the VG03.

Please refer to the instructions ahead and Figure 2.3 for proper connections.



FIGURE 1.1 - M12 splitter
Notice the channel numbering on the splitter.

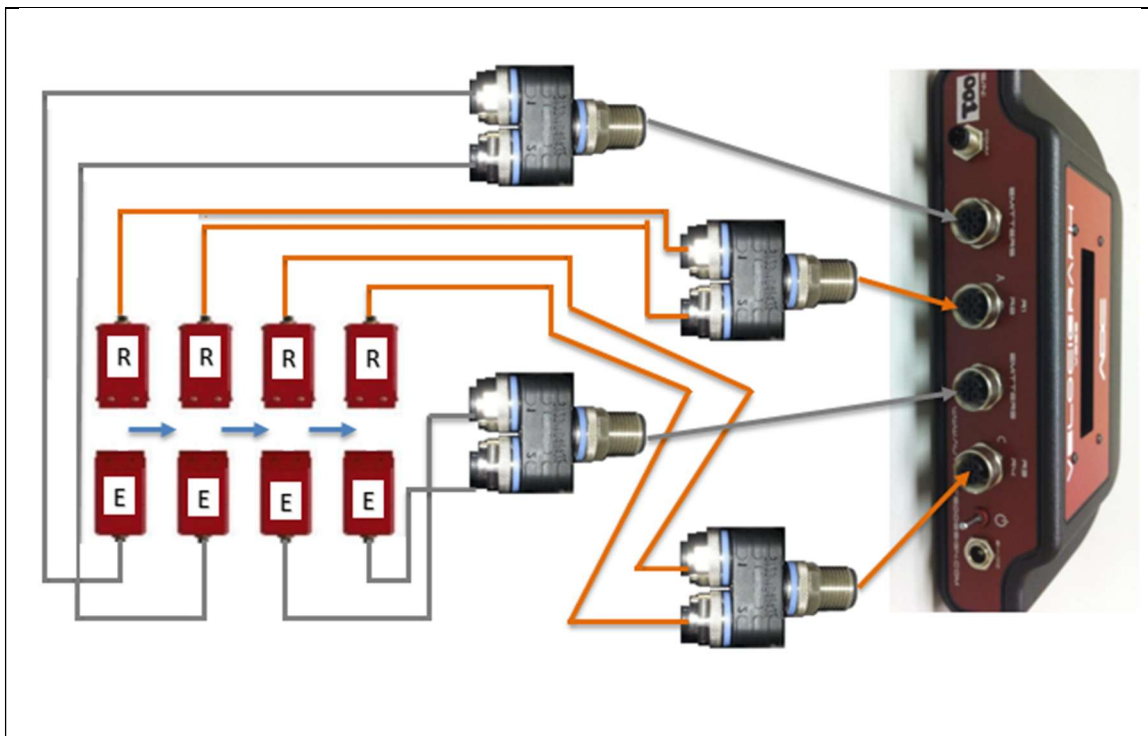
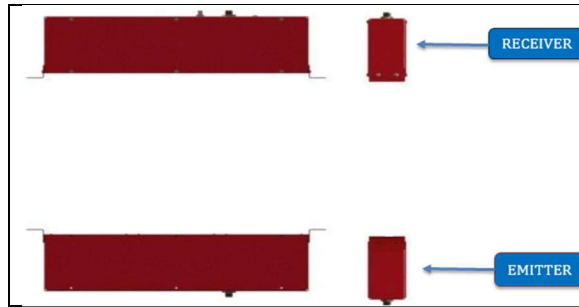


FIGURE 1.2 - Illustration for connecting 4 set of sensors. The blue arrows indicate the path of the object as it enters from left to right triggering all sensors.

NOTE: The sole purpose of this diagram is to illustrate proper connections and does not depict any real setup.

Begin by connecting the light source, or EMITTER, for your sensors to the EMITTER connections on the VG03. Emitters can be connected in any order.



For iBeam sensors, simply use the cables provided and connect to the EMITTER port on your VG03. For sensors from other manufacturers, see the documentation that came with your sensor.

Source connections provide supply power for any sensor light source (24VDC output). Be sure to connect the emitters to the proper pins of the source connector, and that the emitter can accept

24 VDC as the input power, or damage can result.

Next, connect the sensor RECEIVER to the VelociGraph. The RECEIVER connections *must be connected in the order of the ball path*, the RECEIVER A is the receiver closest to the entry path of the projectile, and the RECEIVER C is the final receiver in the path of flight.

Connect the AC Adaptor to the +24 VDC Female plug on the back of the enclosure. Please be sure to use the AC Adaptor provided with the VelociGraph.

Step 3 - Reporting the Results

Before trouble shooting the device, you must configure the VG03 unit. Keep in mind that all configurations and trouble shooting should be done on a separate computer to avoid communication interruptions.



FIGURE 1.3 – Computer connection with RS485 programming cable.

First, connect the programming cable to the computer. When you plug in the programming cable (cable with a USB) to your computer, it will establish a communication port or COM#. There is no default COM# the computer will use however, you can check which COM# your computer uses by doing the following:

Windows 7

Go to Control Panel,

- Click on **Hardware & Sound**. Under **Devices and Printers**, click on *Device Manager* (the Device Manager window will pop-up).

- On the *Device Manager* window, Scroll-down to **Ports (COM & LPT)**. There should be a **USB Serial Port(COM#)** item. This is the COM number you will use on your computer for the VG03Config and Foxterm software.

Windows XP

Go to Control Panel,

- Double-click on *Administrative Tools*, double-click on *Computer Management*, the Computer Management Window will pop-up.
- Under **Computer Management (Local)** tree view, click on **Device Manager**.
- Go to **Ports (COM & LPT)**, there should be a **Communication Port(COM#)**. This should be the COM number you will use on your computer for the VG03Config and Foxterm software

Next, open the VG03Config software. Select the proper COM# (from the instructions above) and click **SEEK**. The Velocigraph will need the following settings:

Mode: *Net Only Mode*

Deadtime: *300* microseconds

TripLevel: *5* volts

When done, click **WRITE**. Power off the VG03 unit and then power back on. You will see the LCD display MODE 04.

NOTE: YOU MUST CLOSE OUT THE VG03CONFIG SOFTWARE BEFORE MOVING ON TO THE NEXT STEP.

Next, open Recorder5.00, click *Connect*, then click *Start Capture*. The program will start recording every pulse it detects and display it on the screen. The last pulse detected will be displayed at the very top. When done, click *Stop Capture*.

(Optional – Do not use this program if Recorder5.00 is being used!)

Next, open Foxterm and click RUN

Go to File, select *New COM port Connection...*

- Under *COM Port Configuration*
 - Port: *Select the same COM#*
- Under *Additional Features*
 - Echo Characters: *true*
- Click Ok.

Foxterm will display all the pulses the VG03 unit will receive. This will help us pin-point where the problem is.

Performing the test.

1. Execute 10 shots through the sensors.

Example output using Recorder5.00

Drop Test – 2x with channel 1 being the top receiver and channel 3 being the bottom receiver

Data				
	Address	Channel	Time	Time Stamp
8	1	1	112.721	1/24/2014 2:49:...
7	1	3	73.0488	1/24/2014 2:49:...
6	1	3	35.6483	1/24/2014 2:49:...
5	1	1	0	1/24/2014 2:49:...
4	1	1	108.033	1/24/2014 2:49:...
3	1	3	69.6012	1/24/2014 2:49:...
2	1	3	33.502	1/24/2014 2:49:...
1	1	1	0	1/24/2014 2:49:...

Sample output data – Latest pulse detected on row 8.

IX. Troubleshooting Guide

1. Is the power switch on?
2. Are you getting error codes?
3. Verify that the sensor receivers and any light sources are receiving power.
4. Verify that the cable connections to the receivers and emitters are good. To check the wiring, switch the cables on the receivers and check if the error code remains the same. If the error code changes, this may indicate a problem with the cable.
5. Be sure that there is nothing interfering with the sensor view. If there is anything between the emitter and receiver, the sensors will not see the projectile. Sometimes dust or debris will block the emitter.
6. If you believe that the data output by the VelociGraph is erroneous, check all distances and confirm that you have configured the VG03 correctly.
7. The VelociGraph is not typically sensitive to electrical noise. However, high-speed sensors *are*. Check for external sources of noise to explain additional pulses.
8. Verify that any other program(s) using COM communication are closed, even the VG03Config program. Disconnect and re-connect the programming cable (i.e. USB

cable) from the computer, not the VelociGraph unit. Verify the COM number (see **VIII section 3**). Open VG03Config and try again.

9. Proper deadtime needs to be set for proper velocity readings. This depends on the type of machine being used with the VelociGraph unit.

For further assistance, you may contact our technical support department in the following ways:

1. Call (630) 783-1150 Mon-Fri 8:00am to 4:30pm Central Standard Time (CST)
2. Email: tbj@automateddesign.com