

---

---

# General I/O Board

---

---

# BV4106-V2

---

---



## **BV4106** **General I/O Board**

Product specification

Oct 2006 V2.i

# General I/O Board

# BV4106-V2

## Contents

1.	Corrections to this section .....	4
2.	Introduction.....	4
3.	Specification .....	4
4.	Electrical Interface.....	4
4.1.	IASI Connector .....	5
4.2.	The 14 pin Connector.....	5
4.3.	Analogue Inputs.....	5
4.4.	Digital Channels .....	5
4.5.	LED Connector .....	5
5.	Electrical Specifications .....	6
6.	Commands .....	6
7.	Digital Channels .....	6
7.1.	DA.....	6
7.2.	DB – see DA .....	7
7.3.	DC – see DA .....	7
7.4.	DD – see DA.....	7
7.5.	DE.....	7
8.	PWM .....	7
8.1.	WA .....	7
9.	Count.....	7
9.1.	CE.....	7
9.2.	CX.....	8
10.	Analogue.....	8
10.1.	PA .....	8
10.2.	PB – see PA .....	9
10.3.	PC – see PA .....	9
10.4.	PD – see PA.....	9
10.5.	VA.....	9
10.6.	VB – see VA.....	9
10.7.	VC – see VA.....	9
10.8.	DD – See VA.....	9
10.9.	TA.....	9
10.10.	TB – see TA.....	9
10.11.	TC – see TA.....	9
10.12.	TD – see TA.....	9
11.	Error codes.....	9
12.	Revisions to the IASI Section .....	<b>Error! Bookmark not defined.</b>
13.	Introduction to IASI .....	<b>Error! Bookmark not defined.</b>
14.	IASI Electrical Interface.....	<b>Error! Bookmark not defined.</b>
15.	Serial Connections .....	<b>Error! Bookmark not defined.</b>
16.	Factory Configuration.....	<b>Error! Bookmark not defined.</b>

---

**General I/O Board**

---

**BV4106-V2**

---

17.	Non-Inverted Mode.....	<b>Error! Bookmark not defined.</b>
18.	Commands .....	<b>Error! Bookmark not defined.</b>
18.1.	Addressing .....	<b>Error! Bookmark not defined.</b>
18.2.	Command Format.....	<b>Error! Bookmark not defined.</b>
18.3.	Command Parameters.....	<b>Error! Bookmark not defined.</b>
18.4.	Command Line (Buffer).....	<b>Error! Bookmark not defined.</b>
19.	Command Set .....	<b>Error! Bookmark not defined.</b>
19.1.	The Star * .....	<b>Error! Bookmark not defined.</b>
20.	Common Command Set (Z) .....	<b>Error! Bookmark not defined.</b>
20.1.	Summary .....	<b>Error! Bookmark not defined.</b>
20.2.	ZA.....	<b>Error! Bookmark not defined.</b>
20.3.	ZB.....	<b>Error! Bookmark not defined.</b>
20.4.	ZC.....	<b>Error! Bookmark not defined.</b>
20.5.	ZD.....	<b>Error! Bookmark not defined.</b>
20.6.	ZF .....	<b>Error! Bookmark not defined.</b>
20.7.	ZK.....	<b>Error! Bookmark not defined.</b>
20.8.	ZL .....	<b>Error! Bookmark not defined.</b>
20.9.	ZM .....	<b>Error! Bookmark not defined.</b>
20.10.	ZR.....	<b>Error! Bookmark not defined.</b>
20.11.	ZT.....	<b>Error! Bookmark not defined.</b>
20.12.	ZV.....	<b>Error! Bookmark not defined.</b>
20.13.	ZW.....	<b>Error! Bookmark not defined.</b>
21.	Z Command Error Codes .....	<b>Error! Bookmark not defined.</b>
22.	Connecting and Configuration .....	<b>Error! Bookmark not defined.</b>
22.1.	Reconfiguring .....	<b>Error! Bookmark not defined.</b>
23.	Microcontroller Use .....	<b>Error! Bookmark not defined.</b>
23.1.	Simple .....	<b>Error! Bookmark not defined.</b>
23.2.	With feedback.....	<b>Error! Bookmark not defined.</b>
23.3.	Baud rate .....	<b>Error! Bookmark not defined.</b>
23.4.	Multiple Devices .....	<b>Error! Bookmark not defined.</b>
24.	Restoring Factory Defaults.....	<b>Error! Bookmark not defined.</b>
24.1.	Software .....	<b>Error! Bookmark not defined.</b>
24.2.	Hardware .....	<b>Error! Bookmark not defined.</b>
25.	Watchdog.....	<b>Error! Bookmark not defined.</b>
26.	Troubleshooting .....	<b>Error! Bookmark not defined.</b>

# General I/O Board

# BV4106-V2

## 1. Corrections to this section

Rev	Change
May 2006	Preliminary
Oct 06	Error corrections and updates to text
Oct 06	Version 2 firmware

## 2. Changes from Version 1

Version 2 firmware has added new commands and modified slightly the way some existing commands work. The changes are as follows.

1. Addition of a count feature added to digital channels B - D
2. Addition of a command that reverts all of the 'extra' functionality back to the default.
3. The alternative functions for Analogue and digital channels are not now mutually exclusive but can be operated together.

## 3. Introduction

The BV4106 is a general purpose digital input / output and analogue input board. It has five digital ports, four that can be configured as either input or output and one for input only. One of the digital ports is optionally connected to a series resistor to drive an LED.

In addition to the digital I/O there are four 10 bit analogue channels that can be either read as an absolute value from 0 to 1023 or as a percentage value from 0 to 100.

Both the analogue and digital channels can perform multiple functions. The digital channels have a pulse width modulator on channel A and can also have counters on channels B through D

The analogue channels can act as triggers to a digital channel that can be useful for temperature alarms and the like.

The board is designed for ease of use and has an on board voltage stabiliser for the analogue reference and microcontroller.

All commands can be entered as simple text and the results seen immediately. There is no complex programming to do.

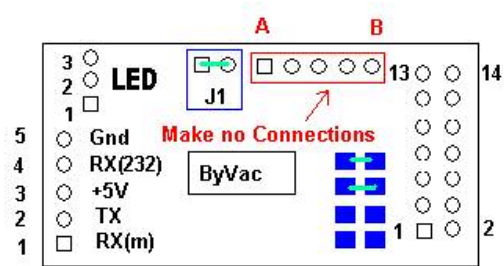
The board has basically 3 interfaces, the serial interface (IASI), the digital interface and the analogue interface. These are dealt with in the sections that follow.

## 4. Specification

- 4 x 10 bit analogue inputs
- Analogue trigger facility

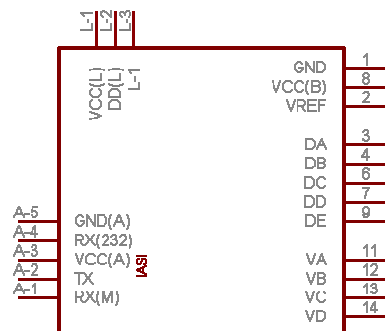
- 4 x digital input or output
- 1 x digital input
- 1 x pulse width modulation o/p
- Optional series resistor
- 4 x counters
- +5V supply
- IASI interface

## 5. Electrical Interface



**Figure 1 Connections**

There are three external connections: the IASI interface, fully described in section **Error! Reference source not found.**; the LED interface and the main 14 pin interface.



**Figure 2 Schematic**

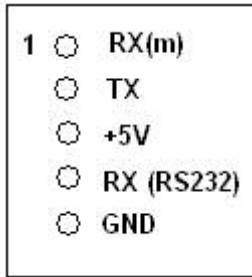
Not all of the pins are used on the 14 pin connector, some are duplicated on the IASI connector. The schematic shows the pins that are likely to be used for each of the 3 connectors.

For quick reference the IASI electrical connections are shown here:

# General I/O Board

# BV4106-V2

## 5.1. IASI Connector (serial interface)



This is the standard connector and the interface is fully described in section **Error! Reference source not found.**

## 5.2. The 14 pin Connector

Pin	Cmd	Description
1		Ground
2		Analogue Reference [1] (output)
3	DA (WA)	Digital I/O A (PWM)
4	DB	Digital I/O B
5		Ground
6	DC	Digital I/O C
7	DD	Digital I/O D (also at J1) [2]
8		+Ve Power (also pin 3 IASI)
9	DE	Digital input E [3]
10		n/c
11	PA VA TA	Analogue channel A
12	PB VB TB	Analogue channel B
13	PC VC TC	Analogue channel C
14	PD VD TD	Analogue channel D

**Table 1 14 Pin connector**

### NOTES

[1] The analogue reference is derived by taking the power from the IASI connector through a 100 ohm resistor and regulating with a 4v7 Zener diode. This arrangement also supplies the processor so there is limited current available at that pin. Connecting an analogue channel to this pin will produce the maximum reading.

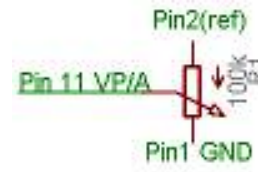
[2] This pin is also connected to pin 2 of the LED connector and can be used to drive an LED. To this end a series resistor has been provided.

[3] This is an input only. Configuring to output will not give an error but it will still remain an input.

## 5.3. Analogue Inputs

There are four analogue inputs capable of resolving to 10 bits (values from 0 to 1023). The reference should be taken from pin 2 as connecting any channel to this pin will give the maximum reading.

The analogue inputs have two functions a) as normal analogue inputs and b) as trigger inputs. This is fully explained in the command section.



**Figure 3 Connecting Analogue Example**

As an example a potentiometer could be connected to an analogue channel. In the case of Figure 3 this is connected to channel A. Note that one end of the potentiometer is connected to pin 2 (vref) and the other to ground.

As usual entering an analogue command, say VA will return a value representing the voltage on pin 11 in text format. This is presented at the terminal.

When the binary option is used, e.g. **VA\*** the command will return **TWO** bytes. The first byte is the most significant byte. This also applies when command **PA\*** is used, in this case the high byte will always be 0.

In addition to the P and V commands there is also the T commands that can be used to trigger a digital output above or below a threshold value.

## 5.4. Digital Channels

There are 5 digital channels. Channels A to D can be configured to either input or output and channel E is input only.

Channel E can be set to output without error however physically it will still be in input.

The digital channels have more than one function:

Channel A can be configured as PWM output

Channels A-D can be configured as trigger outputs for the analogue trigger function

Channels B-E can be configured as counters.

## 5.5. LED Connector

As an option there is an LED connector, it has the following pin-outs

Pin	Description
-----	-------------

# General I/O Board

# BV4106-V2

1	+Ve supply
2	Digital channel D
3	Series resistor (100R)

**Table 2 LED Connector**

This connector is intended to drive an LED and for this it has incorporated a 100R resistor between pins 2 and 3.

To use it to drive an LED connect the LED to pins 1 and 3 and configure channel D as an output. Pulling channel D low will cause the LED to illuminate.

## 6. Electrical Specifications

Supply voltage 4.5V to 6.5V

Digital o/p 20mA

Current Consumption 5.2mA @ 5V

## 7. Commands

The following command descriptions refer specifically to this board. See also section **Error! Reference source not found.** for the IASI specific commands.

Command	BV4106 Digital
DA	Digital channel A
DB	Digital channel B
DC	Digital channel C
DD	Digital channel D
DE	Digital channel E (i/p)
WA	PWM Channel A
CB	Count Channel B
CC	Count Channel C
CD	Count Channel D
CE	Count Channel E
CX	Debounce and clear

Command	BV4106 Analogue
PA	Analogue input A
PB	Analogue input B
PC	Analogue input C
PD	Analogue input D
VA	Analogue input A
VB	Analogue input B
VC	Analogue input C
VD	Analogue input D
TA	Analogue A Trigger

TB	Analogue B Trigger
TC	Analogue C Trigger
TD	Analogue D Trigger

## 8. Digital Channels

There are 4 digital channels that can be configured for either input or output and one digital channel that is input only. The channels can also be used for 'trigger' outputs or as counters. The trigger commands are covered in the analogue section.

At reset the default is for all channels to be set to input with no special functions.

### 8.1. DA

Name: **Digital Channel A**

Command Parameters: [-o][-i][\*][1][0]

Typical Use **DA -o**

Parameter Table	
P	Meaning
-o	Sets the channel to output
-i	Sets the channel to input
*	Returns binary value instead of ASCII value
1	Sets the channel to high when in output mode, ignored when in input mode
0	Sets the channel to low when in output mode, ignored when in input mode

DA Controls the digital channel A. The channel can be set to either input or output. At reset the channel is set to input. Issuing the command without any parameters 'DA' will return the value on the port as text, either '0' or '1'. Using the command with a star (DA\*) will return a single binary byte with a value of either 0 or 1.

The channel is configured to output by following the command with 'dash o', this is an o for 'output' not a zero.

When the channel is configured for output, DA 1 will set the channel high and DA 0 will set the channel low.

### Example

DA -i

DA\*

The above will set the channel to input and then read the value as binary, the value will be returned as a single byte with a value of either 0 or 1

DA -o

# General I/O Board

# BV4106-V2

DA 1

The above will set channel for output and then set that output to high.

**8.2. DB – see DA**

**8.3. DC – see DA**

**8.4. DD – see DA**

**8.5. DE**

Name: **Digital Channel E**

Command Parameters: [\*]

Typical Use **DE**

This is the input only channel and will return either a 0 or 1 depending on the value at the input. DE -o can be issued without error but this will not set the channel to an output, the command will simply be ignored.

## 9. PWM

There is one Pulse Width Modulated output and this is on digital channel A. There is also one command associated with this channel.

**9.1. WA**

Name: **PWM Channel A**

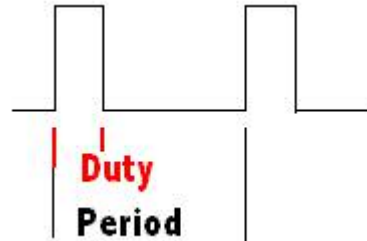
Command Parameters: [-][C][H][L][#][0-100]

Typical Use **WA 50**

Parameter Table	
P	Meaning
-c	Clears the action of the PWM and reverts channel A back to a normal output. ** The trigger command also does this
-h	Sets the output to active high, WA 0 will give a 0 output and WA 100 will give a high output
-l	(L) Sets the output to active low, WA 0 will give a high output and WA 100 will give a 0 output
#	Input next byte as binary
0-100	Set the duty cycle

A pulse width modulator is available at channel A only. When invoked channel A will be set to output.

The PWM has a period of approximately 13ms. The duty cycle can be adjusted from 0 to 100% of this by using the WA command.



**Figure 4 PWM Duty Cycle**

The duty cycle is the active proportion of the period. This active period can be varied. The effect of this is to supply an average power output that can vary the speed of motors or brightness of a light emitter (LED, filament lamp etc.)

The output can either be high or low, the illustration shown in Figure 4 shows a high output. This is set by using the **-H** switch option of the WA command.

In this example a steady state with **WA 0** would give a low (0V) output with no duty cycle. **WA 10** would give a duty cycle of approximately 1.3ms. This would mean at the start of the cycle the output would be high for 1.3ms and low for 11.7ms.

The reverse can be achieved by using the **-L** switch. This caters for devices that are on when low. The **-C** switch clears the action of the PWM and reverts channel A back to a normal output.

**NOTE:** PWM is ONLY available for channel A.

It is possible to set channel A to input after the PWM command (DA-i). This will not switch off the PWM but obviously no output will appear on channel A

It may be convenient, particularly working with microcontrollers to specify the duty cycle in binary. This can be achieved using the # option. The next byte following the #, whatever that may be is accepted as the value for the duty cycle.

### Examples

WA 50                      Set 50% duty cycle

WA -h                      Set high pulses

### MULTI-FUNCTION NOTE

For maximum performance the trigger and count functions should be disabled when using this command. In particular the trigger function will reduce the performance considerably.

## 10. Count

Count is another function of the digital inputs and is only available on version 2 of the BV4106. There are four channels B to E.

**10.1. CB**

Name: **Count**

# General I/O Board

# BV4106-V2

Command Parameters: **[\*][-c][-d]**

Typical Use **CA**

Parameter Table	
P	Meaning
-c	Resets counter to 0 and enables counter function
-d	Disables counter function for this channel
*	Returns binary value instead of ASCII value

The count function is available for counting **changes** to the digital input, each change from high to low or low to high is counted as one. The input from the channel can also be observed with the BE command to discover the current value.

The maximum count value is 65535 (16 bit) and the count always starts from 0.

The counter function is enabled by setting the count to 0 using the following command:

BE -c

The above does not stop the use of the standard digital input or any other function. To read the count value use BE on it's own or with a '\*' for binary representation. The out put will be two bytes, most significant byte first.

NOTE activation of the count (BE-c) will also cause the channels to be set to input.

All of the count channels have switch debounce applied, see the CX command.

## 10.2. CC as CB

## 10.3. CD as CB

## 10.4. CE as CB

## 10.5. CX

Name: **Count control**

Command Parameters: **[nn][\*][-d]**

Typical Use **CX 10**

The count control command is used for globally disabling **all of the alternate functions** and for setting the debounce time.

Using the -d switch is a very convenient way, other than reset (ZR) of ensuring that only the standard functions of the digital and analogue channels are in operation. In other words this will switch OFF count, PWM and Trigger in one operation.

### Debounce

If the input is connected to a mechanical device, a push button or micro switch for example the logic state will not be precisely changed. The transition from 0-1 or vice versa may take a finite amount of time to settle. The actual time of course will vary depending on the mechanical device.

The debounce mechanism uses the same period as that used for the PWM period which is approximately 13ms. The count control can set the number of periods to use as a delay.

NOTES:

1. The debounce is always active, setting CX to 0 will give 13ms
2. CX begins at zero so setting CX to 1 will give 2 periods, approximately 26ms
3. The current setting is stored in EEPROM and so remains the same during power downs.

The CX command without any parameter will display the current setting.

## 11. Analogue

The BV4106 has four analogue channels designated from A to D. There are three options for each of these, V will return an absolute value, P will return a percentage value and T is a trigger facility that is used in combination with the digital outputs.

### 11.1. PA

Name: **Percentage value of Analogue A**

Command Parameters: **[\*]**

Typical Use **PA**

The analogue channels are analogue inputs and have two options for the return values. Either as a percentage or as an absolute value.

The PA command will return a percentage, this is an internal integer calculation based on a maximum input of 1023. Thus an absolute value of 511 will give a percentage value of 50.

The voltage reference used for this is 4.7V. This value can be obtained from pin 2 and cannot be altered.

By default, without the '\*' the command will return a text value representing the value of the analogue voltage. In the above example if 511 was the value (approximately 2.38V), two bytes 53 (= ASCII 5) and 48 (= ASCII 0) will be returned. This will be shown on a terminal as 50. The number of bytes returned **without** the '\*' will of course depend on the value. Single digit numbers will only return one byte whereas 100 will return 3 bytes.

The '\*' parameter tells the command to return the value in binary and this will always return **two** bytes regardless of the value. The first byte is the most significant value. In the above

## General I/O Board

## BV4106-V2

example the first byte will be 0 and the second byte will be 50 (32h).

Using this particular command can only return a maximum value of 100 so the first byte will always be a 0.

**11.2. PB – see PA**

**11.3. PC – see PA**

**11.4. PD – see PA**

**11.5. VA**

Name: **Absolute value of Analogue A**

Command Parameters: [**\***]

Typical Use **VA**

This is exactly the same command as PA except the output is an absolute 10 bit value from 0 to 1023.

The default is to convert this value to text for displaying on a terminal. If the '\*' option is used then this value will be output as binary. The output is 2 bytes, the high value being output first.

**11.6. VB – see VA**

**11.7. VC – see VA**

**11.8. DD – See VA**

**11.9. TA**

Name: **Digital Trigger for Analogue A**

Command Parameters: [**-c**][**C T V**]

Typical Use **TA 1 63 0**

Parameter Table	
P	Meaning
-c	Clears the action of the trigger and reverts the Analogue input back to normal
C	Digital channel number from 0 to 3, 0 = A, 3= D
T	Threshold, a value between 0 to 127 ** See text
V	Value digital channel is set to when threshold is exceeded

The trigger command is used for outputting either a high or low on a specified digital channel depending on the value of an analogue <H:\Zed\ASCII-Me\2006-documents\sub-IASI-description-688.doc>

input. This can be used for end stops in motors, infrared slot switches, thermostat regulation etc.

TA is analogue channel A and can be mapped to any digital output channel A through D where A=0 and D=3. The threshold and value work together to determine the output state of the selected digital channel. The channel used is automatically set to output.

The TA command expects either -c **OR** three parameters.

In the above example (**TA 1 63 0**) the output on channel B will go low (0) when the analogue value reaches or exceeds half value. It will return high when the output is below half value. The analogue value internally is the absolute value divided by 8. To calculate what value to use the following equation can be used:

$$\text{Value} = \text{absolute\_value} / 8$$

As an example suppose that digital channel D needs to go high when the voltage on the analogue channel A exceeds 1.3 volts:

Using the reference voltage on pin 2 of 4.7V, 1.3V is 28% of this or an absolute value of 286. The value is therefore:

$$286 / 8 = 36 \text{ OR } 28\% \text{ of } 127 = 36$$

so the following command is needed:

**TA 3 36 1**

To explain, **TA** will look at the input from analogue channel A, **3** is the channel that will be changed, D in this case.

The **36** and **1** work together so that if the input of analogue channel A (PA) reaches or exceeds 36 then digital output D will go high. It will remain high while ever the analogue input is >=36. If the input drops below 36 then digital output D will go low.

### MULTI-FUNCTION NOTE

This function can be used at the same time as the count or PWM command but as it requires to scan the input it will effect the performance of the PWM and Count commands. In particular the PWM command.

**11.10. TB – see TA**

**11.11. TC – see TA**

**11.12. TD – see TA**

## 12. Error codes

There are no error codes specific to this board. Standard IASI error codes apply.