

VME  
DIGITAL I/O  
MODULE  
FAMILY

Manual Part Number: 11026019A

## **COPYRIGHT**

C&H Engineering, Inc. (C&H) provides this manual "as is" without warranty of any kind, either expressed or implied, including but not limited to the implied warranties of merchantability and fitness for a particular purpose. C&H may make improvements and/or changes in the product(s) and/or program(s) described in this manual at any time and without notice.

This publication could contain technical inaccuracies or typographical errors. Changes are periodically made to the information herein; these changes will be incorporated in new editions of this publication.

**Copyright © 1993 by C&H Engineering, Inc.**

The information and/or drawings set forth in this document and all rights in and to inventions disclosed herein which might be granted thereon disclosing or employing the materials, methods, techniques or apparatus described herein, are the exclusive property of C&H Engineering, Inc.

A Reader's Comment Form is provided at the back of this publication. If this form has been removed address comments to:

C&H Engineering, Inc.  
Technical Publications  
P. O. Box 14765  
Austin, Texas 78761-4765

C&H may use or distribute any of the information you supply in any way that it believes appropriate without incurring any obligations whatever.

## **VME/VXI MODULE WARRANTY**

C&H Engineering, Inc. warrants its VME/VXI products to be free from defects in material and workmanship for one year from date of shipment. C&H will repair or replace the defective product without charge within the warranty period, provided the defective item is shipped, freight prepaid, to C&H Engineering, at 15809 Vision Drive, Pflugerville, TX 78660. C&H will pay return freight charges to any point in the continental United States or Canada.

Obligations under this warranty shall be limited to repair or replacement, at C&H's discretion, of any product or part thereof which has been returned by the original purchaser with transportation prepaid and, upon examination by C&H, found to be defective. C&H assumes no responsibility for loss or damage to equipment being returned for repair or replacement under the terms of this warranty. Equipment which, upon examination by C&H, requires repair or replacement of parts thereof as a result of improper installation, misuse, unauthorized alterations or repairs, or user negligence, will have such repairs or replacement of parts made at then current rates.

This warranty does not cover damage caused by misuse, neglect, accident, or improper application or installation. C&H shall not be liable for consequential damages of any kind arising out of the purchase, installation, use or misuse of the product. C&H makes no representation or warranty of any kind, either expressed or implied, with respect to equipment operation or procedures. Any action that the user may take in reliance upon the operation or accuracy of this equipment shall be taken solely at the user's own responsibility and risk.

Please notify the C&H sales department to obtain a Return Authorization Number (RAN) prior to return of a product under the terms of this warranty. Notification is to include the Model and Serial numbers of the product along with full details of the problem. Modules returned should clearly show the RAN on the outside of the package.

## **AMENDMENT NOTICE**

C&H Engineering, Inc. makes every attempt to provide up-to-date manuals with the associated equipment. Occasionally, changes are made to the equipment wherein it is necessary to provide amendments to the manual. If any amendments are provided for this manual they are printed on colored paper and will be found at the rear of this manual.

## **NOTE**

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

## INTRODUCTION

This manual describes the operation and maintenance of the C&H 32-Bit Digital Input/Output (I/O) Family of VME modules. These modules represent a subset of the test and data acquisition/control modules in the VME and VXI format provided by C&H.

Contained within this manual is information on the physical and electrical specifications, installation and startup procedures, operating procedures, functional description, figures and diagrams required to adequately use this product.

The part numbers covered by this manual are:

<u>Part Number</u>	<u>Model</u>	<u>Description</u>
11026015	T32I/O	32-Bit Input/Output (TTL)
11026020	C32I/O	32-Bit Input/Output (CMOS)
11026025	T32I50	32-Bit Input, 50 ohm (TTL Threshold)
11026030	C32I50	32-Bit Input, 50 ohm (CMOS Threshold)
11026035	D32O	32-Bit Output, Open Collector





## TABLE OF CONTENTS

<b>1.0</b>	<b>GENERAL DESCRIPTION</b> .....	1
1.1	PURPOSE OF EQUIPMENT .....	1
1.2	SPECIFICATIONS OF EQUIPMENT.....	1
1.2.1	Key Specifications.....	1
1.2.2	Electrical.....	1
1.2.3	Mechanical.....	3
1.2.4	Environmental.....	3
1.2.5	Bus Compliance.....	3
<b>2.0</b>	<b>INSTALLATION</b> .....	5
2.1	UNPACKING AND INSPECTION .....	5
2.2	HANDLING PRECAUTIONS .....	5
2.3	INSTALLATION.....	5
2.4	PREPARATION FOR RESHIPMENT .....	5
<b>3.0</b>	<b>FUNCTIONAL DESCRIPTION</b> .....	7
3.1	GENERAL.....	7
3.2	ADDRESSING .....	7
3.3	INPUT/OUTPUT CONTROL REGISTERS .....	8
3.4	INPUT/OUTPUT TERMINATION .....	8
3.5	CONNECTORS.....	10
<b>4.0</b>	<b>OPERATING INSTRUCTIONS</b> .....	11
4.1	NORMAL OPERATION .....	11
4.1.1	Address Switch Selection .....	11
4.1.2	VME Control of Module .....	11
4.2	PROGRAM FLOW .....	11
<b>5.0</b>	<b>MAINTENANCE</b> .....	15
5.1	BUILT IN TEST AND DIAGNOSTICS .....	15
5.2	TROUBLE ANALYSIS GUIDE.....	15

## LIST OF FIGURES

Figure 2.	Board Layout.....	9
Figure 3.	Front Panel .....	10
Figure 4.	Address Switch Configuration.....	11
Figure 5.	Program Flow for I/O Modules.....	14

## LIST OF TABLES

Table I -	Address Mode Selection Functions .....	12
Table II.	Input/Output Control.....	13



## 1.0 GENERAL DESCRIPTION

The five members of the 32-bit digital I/O family are VMEbus compatible modules that provide general purpose digital input/output capability. Models T32I/O and C32I/O have 32-bit input and output capability with either TTL or CMOS drive/receive characteristics. Models T32I50 and C32I50 provide 32-bit input only with 50 ohm termination impedance and either TTL or CMOS input threshold characteristics. Model D32O is a 32-bit output only device with open collector outputs.

### 1.1 PURPOSE OF EQUIPMENT

These modules are well suited for applications within ATE systems, data acquisition systems, communications interface, hardware-in-the-loop simulation systems as well as development laboratory environments.

### 1.2 SPECIFICATIONS OF EQUIPMENT

#### 1.2.1 Key Specifications

- Readback capability of all driver states
- Provisions for user to add custom bus termination or current limiting resistors
- Output drive enable/disable (output modules only)
- Locking mass termination ribbon cable compatible input/output connectors

#### 1.2.2 Electrical

The modules requires +4.5V to +5.5V at 1.5 amps (typical) for proper operation. The actual power requirements will depend on the driver characteristics and output signal loading.

#### OUTPUT CHARACTERISTICS:

##### Model T32I/O Only

Driver Type:	74LS126
V <sub>OH</sub>	2.4V min.
V <sub>OL</sub>	0.5V max.
I <sub>OH</sub>	2.6 mA max.
I <sub>OL</sub>	24.0 mA max.

Model C32I/O Only (see note 1)

Driver Type: 74HCT126  
 $V_{OH}$  4.9V - (150 X  $I_{LOAD}$ ) V  
 $V_{OL}$  0.1V + (150 X  $I_{LOAD}$ ) V  
 $I_{OH}$  30mA max.  
 $I_{OL}$  30mA max.

Model D32O Only

Driver Type: 74S38  
 $V_{OH}$  5.5V max  
 $V_{OL}$  0.5V max  
 $I_{OH}$  250  $\mu$ A (see note 2)  
 $I_{OL}$  60mA max

INPUT CHARACTERISTICS: (see note 3)

Model T32I/O and T32I50

Input Device: 74ALS245 or 74LS245  
 $V_{IH}$  2.0V min  
 $V_{IL}$  0.7V max  
 $I_{IH}$  20.0  $\mu$ A max  
 $I_{IL}$  0.1mA max

Model C32I/O and C32I50

Input Device: 74HC245  
 $V_{IH}$  3.15V min (see note 4)  
 $V_{IL}$  0.9V max (see note 4)  
 $I_{IH}$  10.0  $\mu$ A  
 $I_{IL}$  10.0  $\mu$ A

NOTES:

- 1) Assumes factory installed 150 ohm current limiting resistors.
- 2) Assumes no pullup resistors.
- 3) Assumes no user optional custom termination added. The T32I50 and C32I50 have 50 ohm 1/2 watt resistors on the input lines just prior to the receiver device.
- 4) Damage may result if external voltages are applied, in excess of 20mA, to a CMOS input device that has its VCC power removed. Therefore remove all external sources prior to removing power from this module.

### 1.2.3 Mechanical

The mechanical dimensions of the module are in conformance with the VMEbus specification (Rev. C.1) for single slot size 'B' modules. The nominal dimensions are 233.35mm (9.187 in) high x 160mm (6.299 in) deep.

### 1.2.4 Environmental

The environmental specifications of the module are:

Operating Temperature: 0°C to +55°C

Storage Temperature: -40°C to +75°C

Humidity: <95% without condensation

### 1.2.5 Bus Compliance

The module complies with the VMEbus Specification ANSI/IEEE STD 1014-1987, IEC 821 and IEC 822 for a Data Transfer Bus (DTB) Slave. The standard addressing configuration is A32/A24/A16:D16/D08(E0).

Neither SYSFAIL nor interrupts are supported. IACKIN is tied directly to IACKOUT and BRX is tied directly to BGX.







## **2.0       INSTALLATION**

### **2.1       UNPACKING AND INSPECTION**

In most cases the VME Digital I/O Module will have been individually sealed and packaged for shipment. Verify that there has been no damage to the shipping container. If damage exists then the container should be retained as it will provide evidence of carrier caused problems. Such problems should be reported to the carrier immediately as well as to C&H. If there is no damage to the shipping container, carefully remove the module from its box and plastic bag and inspect for any signs of physical damage. If damage exists, report immediately to C&H.

### **2.2       HANDLING PRECAUTIONS**

The VME Digital I/O Module contains components that are sensitive to electrostatic discharge. When handling the module for any reason, do so at a static-controlled workstation, whenever possible. At a minimum, avoid work areas that are potential static sources, such as carpeted areas. Avoid unnecessary contact with the components on the module.

### **2.3       INSTALLATION**

Set or verify the module's logical address. Insert the module into the appropriate slot according to the desired priority. Apply power. If no obvious problems exist, proceed to communicate with the module as outlined in Section 4.0 (Operating Instructions).

### **2.4       PREPARATION FOR RESHIPMENT**

If the module is to be shipped separately it should be enclosed in a suitable water and vapor proof plastic bag. Heat seal or tape the plastic bag to insure a moisture-proof closure. When sealing the bag, keep trapped air volume to a minimum.

The shipping container should be a rigid box of sufficient size and strength to protect the equipment from damage. If the module was received separately from a C&H system, then the original module shipping container and packing material may be re-used if it is still in good condition.



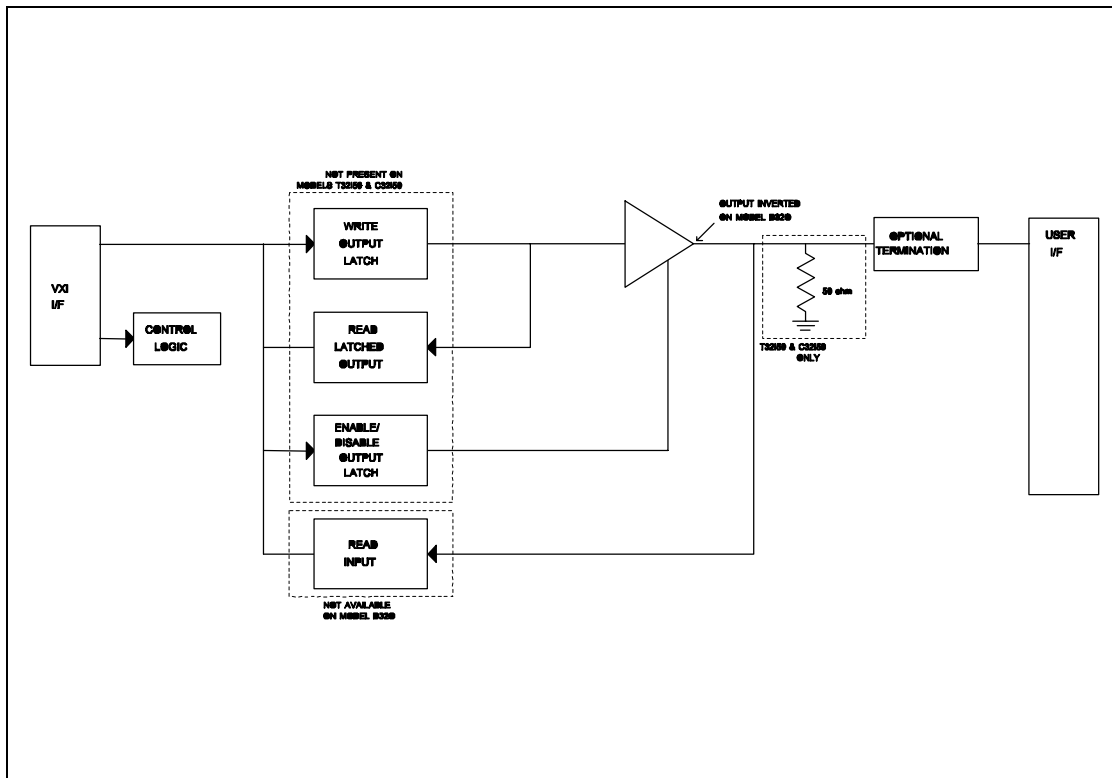




### 3.0 FUNCTIONAL DESCRIPTION

#### 3.1 GENERAL

The Digital I/O family of modules operate identically with respect to VME addressing and decoding, however, they differ in input/output capabilities. Models T32I/O and C32I/O allow each pin to be an input or output pin, however, they do not offer controlled termination. Models T32I50 and C32I50 are input only, but provide 50 ohm input impedance. Model D32O is output only, but provides open-collector output characteristics.



A functional block diagram is shown in Figure 1.

#### 3.2 ADDRESSING

Address decoding is provided via four 8-bit select switches (S1 - S4). The setting of these switches determines whether the module is selected during a VME read or write cycle. A16, A24, and A32 address modes are available. Refer to 4.1.1 for details on the setting of these switches. All modules supports D08 (even/odd) capability; therefore, write data can be on an 8-bit or 16-bit basis. Reads are always on a 16-bit basis and the host processor retains only the bits it requires.

### 3.3 INPUT/OUTPUT CONTROL REGISTERS

Four types of registers are used to control the input and output of the digital data. They are:

- Write Output Latch (not used on T32I50 and C32I50)
- Read Latched Output
- Enable/Disable Output Driver Latch (not used on T32I50 and C32I50)
- Read Input (not used on D32O)

Write Output Latch These registers control the data pattern output to the front panel connectors. Positive logic is used on models T32I/O and C32I/O. However, on the D32O (open-collector) module, a 1 written to this register places the output driver in the on state (if the driver is enabled), and a 0 places the driver in the off state. Note that the D32O module effectively inverts the output. These registers are not used on models T32I50 and C32I50.

Read Latched Output These registers contain the latched output data and should correspond to the last data written to the Write Output registers. These registers provide read back of the output drivers input state for write verification and diagnostics.

Enable/Disable Output Driver Latch These registers enable or disable the output drivers. For models T32I/O and C32I/O, a low (0) disables (tri-states) the output of the respective driver, a high (1) enables the output driver. For model D32O, a low (0) disables the driver and places it in the off state, a high (1) enables the output driver. These registers are not used on models T32I50 and C32I50.

Read Input These registers contain the input level present at the module's front panel connector. These registers are not available on the D32O module.

### 3.4 INPUT/OUTPUT TERMINATION

All models have provisions for customizing the input termination. The input signals from the connectors are routed through optional terminator packages to the receiver device. Note that an input signal is electrically the same as an output signal on models that support input and output. Referring to Figure 2, RP1, RP4, RP7, and RP10 provide an optional "pull up" to 5 volts and RP2, RP5, RP8, and RP11 provide an optional "pull down" to ground. These referenced locations are designed to accept standard SIP style resistor packs and allow the user to customize the input termination in 8-bit increments.

#### **NOTE**

On model C32I/O (CMOS), if no custom termination is used, it is recommended that a 100K ohm resistor be installed in RP2, RP5, RP8, & RP11 for ESD protection. Models T32I50 and C32I50, are shipped with 50 ohm 1/2 watt termination resistors. These resistors are in parallel to any component added to RP2, RP5, RP8, or RP11.

Figure 2. Board Layout

### 3.5 CONNECTORS

The digital I/O interface is through four connectors located on the front panel of the module. Each connector contains eight (8) signals, starting with 1 through 8 on the top connector J1. The signals are on the odd pins and their associated grounds are on the adjacent even pin. The connectors are 3M type 3408 compatible with locking arms to help secure the mating connector.

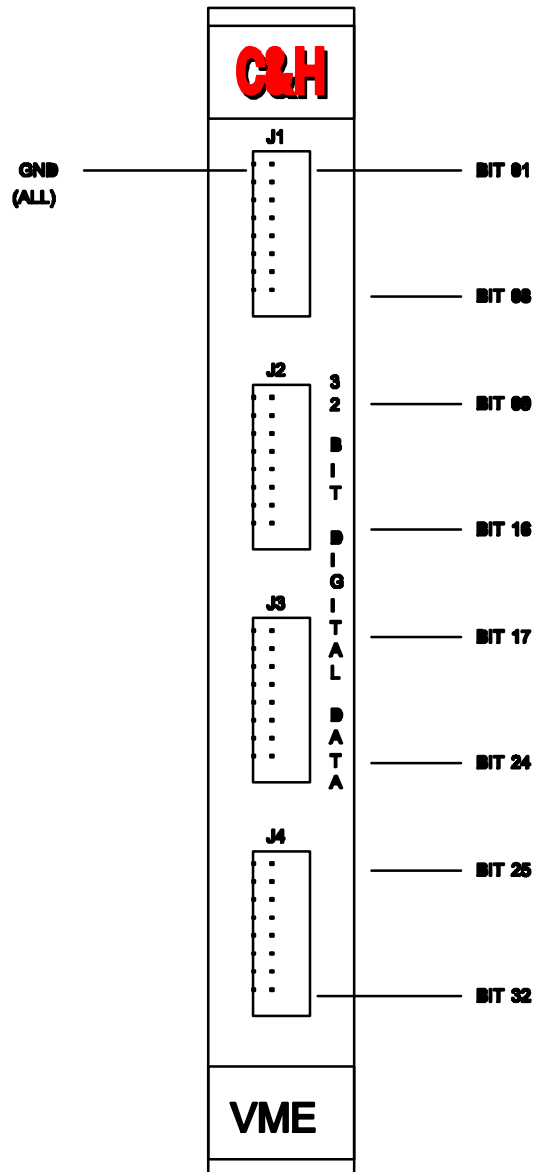


Figure 0. Front Panel







## **4.0 OPERATING INSTRUCTIONS**

### **4.1 NORMAL OPERATION**

Prior to installation, the module's VME address and address mode must be set according to the following section.

#### **4.1.1 Address Switch Selection**

Module access is a function of the address mode select switches (S3), the address select switches (S1, S2, and S4), and the VME host address and modifier code. The address mode select switches (ID12 and ID13) determine the address ranges (A16, A24, or A32) and the address modifier codes that must be valid to access the module. See Table I for valid address modes, address modifiers and address ranges and Figure 4 for switch configurations.

ID13

ID12

ADDRESS  
MODE

VALID AM

VALID MODULE ADDRESS RANGE

VA31 through VA00 (see notes)

OFF

(1)

OFF

(1)

A16 ONLY

29

2D

XXXX0000 through XXXXFFC0

ON

(0)

ON

(0)

A16/A24

29

2D

and

39

3A

3B

3D

3E

3F

XXXX0000 through XXXXFFC0

and

XX000000 through XXFFFFC0

ON

(0)

OFF

(1)

A16/A32

29

2D

and

09

0A

When the address modifier bits coincide with the address mode selected, the VME address bits are compared with the module address selection switches (S1, S2, and S4) and a signal to the control logic will flag a valid address decode. Only those addresses that are appropriate to the address mode selected are used by the address decode logic.

#### 4.1.2 VME Control of Module

During a valid VME read/write cycle, when the address modifier code coincides with the address mode selected and the VME address coincides with the address selected, the VME host processor may access the module. Table II shows the use and address location of the data words that control the functions of the module.

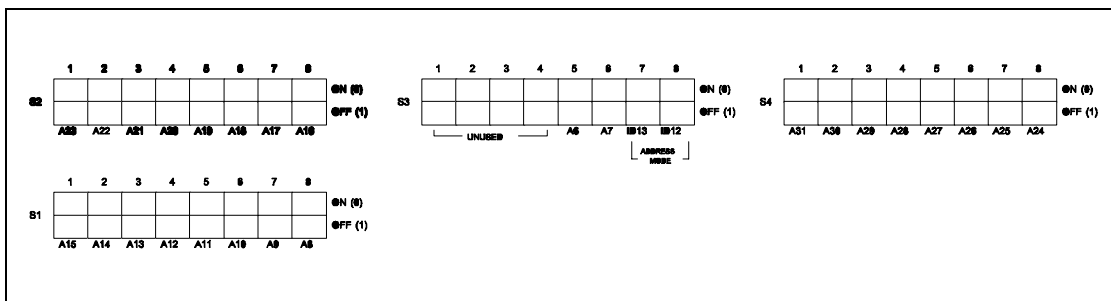


Figure 0. Address Switch Configuration

Table IV. Input/Output Control  
VA05-VA00

FUNCTION	READ
	00
Read Latched Output (bits 16-1)	(J2-J1)
	02
Read Latched Output (bits 32-17)	(J4-J3)
	04
Read Input Data (bits 16-1)	(J2-J1)
	06
Read Input Data (bits 32-17)	(J4-J3)
	WRITE
	00
Write Output Data (bits 16-9)	(J2)
	01
Write Output Data (bits 8-1)	(J1)
	02
Write Output Data (bits 32-25)	(J4)
	03
Write Output Data (bits 24-17)	(J3)
	04 - 0B
Not Used	
	0C
Enable/Disable Output Driver (bits 16-9)	(J2)
	0D
Enable/Disable Output Driver (bits 8-1)	(J1)
	0E
Enable/Disable Output Driver (bits 32-25)	(J4)
	0F
Enable/Disable Output Driver (bits 24-17)	(J3)

NOTES:

1. VA05-VA00 = 06 through 3F are unused
2. The modules support D16 and D08(E0) data transfers; therefore, 16-bit patterns may be written in one command to even addresses.

4.2 PROGRAM FLOW

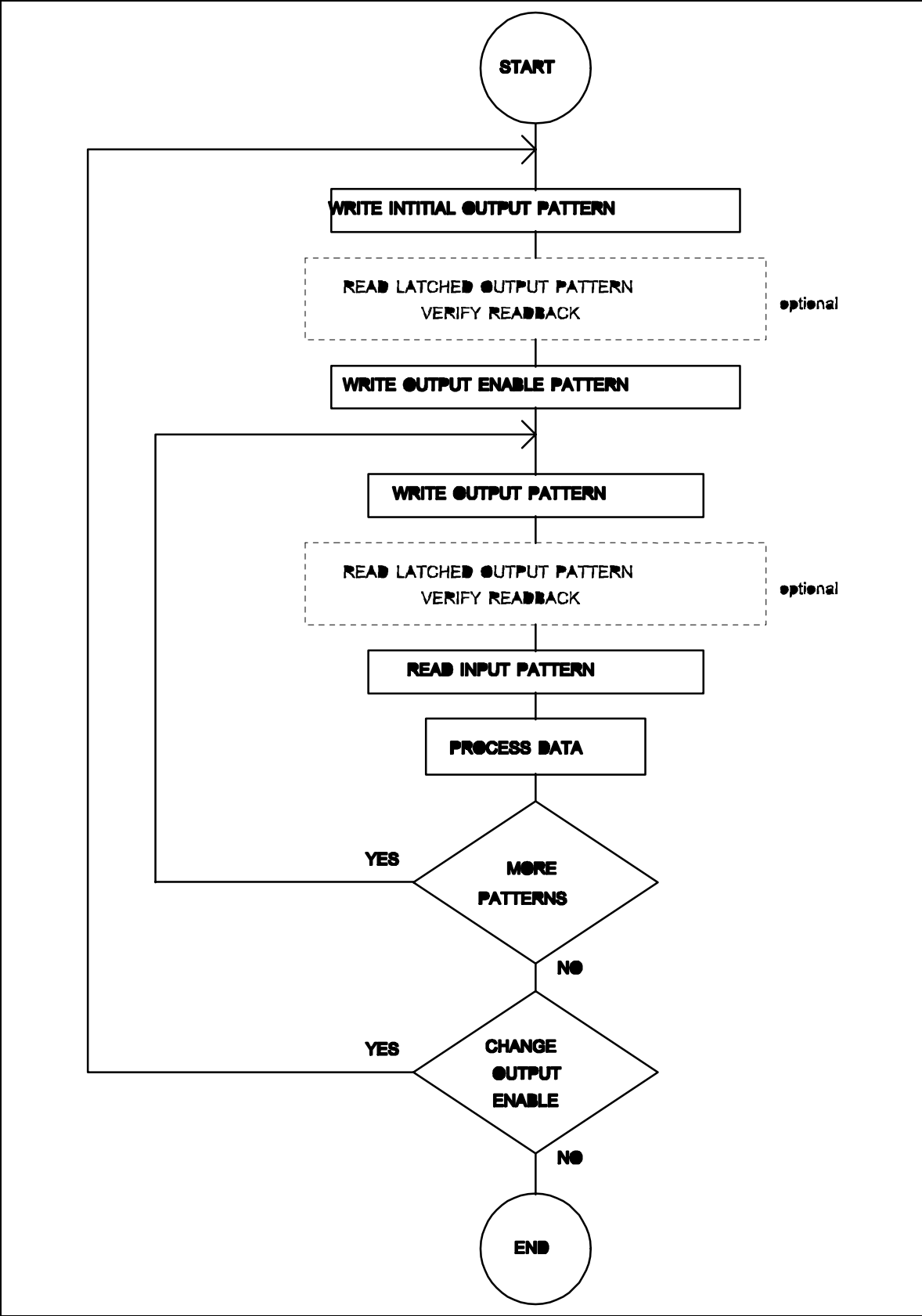


Figure 0. Program Flow for I/O Modules

An example program flow is shown in Figure 5. This example is for the input/output models, but can be easily modified for the other models.









## **5.0 MAINTENANCE**

### **5.1 BUILT IN TEST AND DIAGNOSTICS**

A simple diagnostic routine can be written that uses the read back capability of the modules to insure proper operation up to the driver devices.

### **5.2 TROUBLE ANALYSIS GUIDE**

If a bus error or bus timeout error occurs, verify that the address and mode switch settings are properly set for the system access type. Verify correct program addressing and word size and check the system memory mapping strategy.

If bit errors occur, utilize the modules read back capability to verify the module's internal states. When diagnosing output problems, isolate the module from external loads by removing the connectors. On models T32I/O and C32I/O, verify that the input to the output driver matches the output of the driver when it is enabled. In some cases, an oscilloscope or logic analyzer may be useful, especially on model D32O where read back of the output driver is not supported.



**NOTES:**



## **READER'S COMMENT FORM**

Your comments assist us in improving the usefulness of C&H's publications; they are an important part of the inputs used for revision.

C&H Engineering, Inc. may use and distribute any of the information that you supply in any way that it believes to be appropriate without incurring any obligation whatsoever. You may, of course, continue to use the information which you supply.

Please refrain from using this form for technical questions or for requests for additional publications; this will only delay the response. Instead, please direct your technical questions to your authorized C&H representative.

COMMENTS:

Thank you for helping C&H to deliver the best possible product. Your support is appreciated.

Sincerely,

F.R.Harrison  
President and CEO

## INSTRUCTIONS

In its continuing effort to improve documentation, C&H Engineering, Inc. provides this form for use in submitting any comments or suggestions that the user may have. This form may be detached, folded along the lines indicated, taped along the loose edge (DO NOT STAPLE), and mailed. Please try to be as specific as possible and reference applicable sections of the manual or drawings if appropriate. Also, indicate if you would like an acknowledgement mailed to you stating whether or not your comments were being incorporated.

NOTE: This form may not be used to request copies of documents or to request waivers, deviations, or clarification of specification requirements on current contracts. Comments submitted on this form do not constitute or imply authorization to waive any portion of the referenced document(s) or to amend contractual requirements.

\_\_\_\_\_ (Fold  
along this line)

\_\_\_\_\_ (Fold  
along this line)

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

C&H Engineering, Inc.  
Technical Publications  
P. O. Box 14765  
Austin, Texas 78761-4765

Pl ac e St a m p H er e
----------------------------------------------------