Appendix I

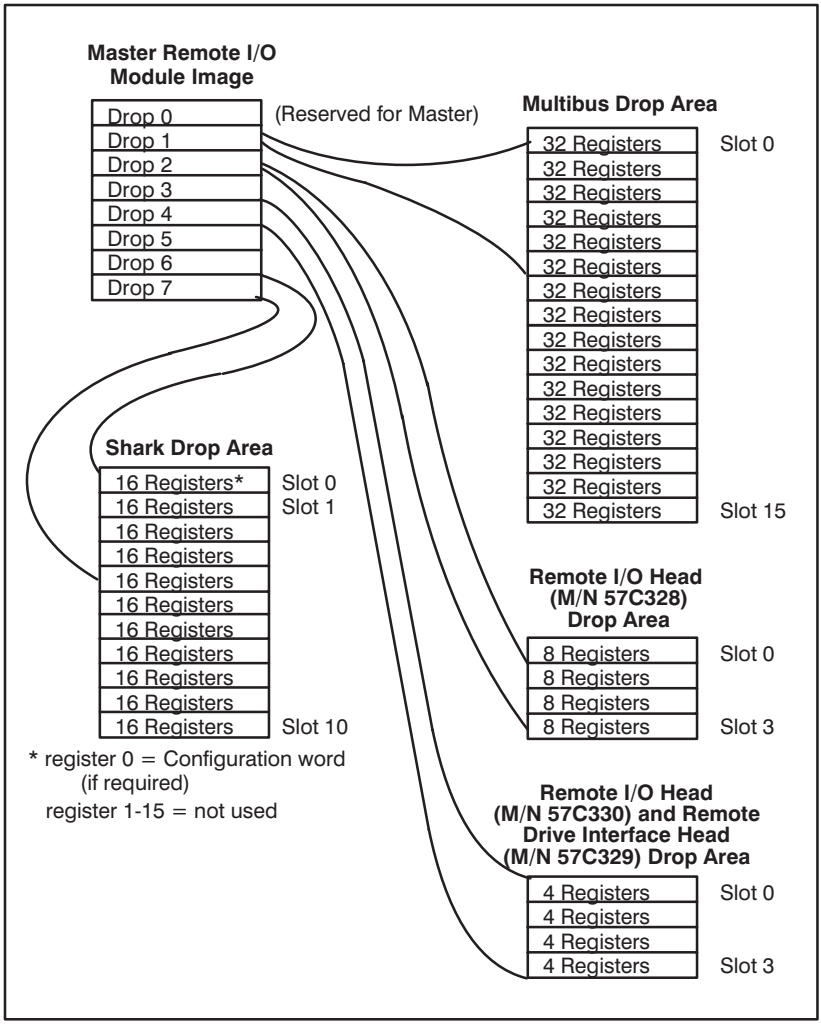
Remote I/O Memory Mapping

The basic organization of the dual port memory in the AutoMax master Remote I/O module is described in sections 4.1 and 4.2. This appendix describes in detail how registers/bits in the four different types of remote I/O drops (Multibus, Remote I/O Head, Remote Drive Interface Head, and Shark) are mapped in the AutoMax master Remote I/O module.

Recall that the memory map of the remote I/O network maintained by the Remote I/O master is called an image. The image is divided into eight drop areas, with the drop 0 area always reserved for the master Remote I/O module, and drops 1 through 7 used for imaging slave remote I/O drops.

Each drop area is divided into a number of slot areas for imaging the individual slots in the slave drops. The number of slot areas, as well as the number of registers in each slot area, depends on the type of remote I/O. The following figure illustrates the memory mapping of the remote I/O network on the master Remote I/O module, including slot and register mapping for all three types of remote I/O.

The information in this appendix will be particularly useful for configuration purposes. If you are using AutoMax Programming Executive V2.1 or earlier, you will need to create a configuration task to define the name and location all of the I/O in your application. If you are using AutoMax Programming Executive software V3.2 or later, you enter configuration information on pre-defined screens.


Master Remote I/O Module Image
Drop 0
Drop 1
Drop 2
Drop 3
Drop 4
Drop 5
Drop 6
Drop 7
(Reserved for Master)
Multibus Drop Area
32 Registers
Slot 0
Slot 15
Shark Drop Area
16 Registers*
16 Registers
Slot 0
Slot 1
Slot 10
* register 0 = Configuration word (if required)
register 1-15 = not used
Remote I/O Head (M/N 57C328) Drop Area
8 Registers
Slot 0
Slot 3
Remote I/O Head (M/N 57C330) and Remote Drive Interface Head (M/N 57C329) Drop Area
4 Registers
Slot 0
Slot 3

Appendix I (Continued)

Multibus Drops

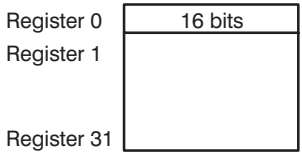
In the master Remote I/O module, the image area for each Multibus drop is divided into 16 slot areas containing 32 16-bit registers. One slot area is reserved for the slave Remote I/O module. The remaining 15 slot areas (in 16-slot racks) or 9 slot areas (in 10-slot racks) can be used for any general purpose digital or analog module with 32 or fewer registers. Register mapping for each slot area begins at 0 and continues through to 31 in consecutive order.

Multibus Drop Restrictions (per drop):
- Maximum number of input registers: 120
- Maximum number of output registers: 120
- Maximum total number of input and output registers: 190
  (only the first 190 registers will be recognized; all others will be ignored)

Example #1

A 16-point (bit) digital input module in slot 5 of drop 2 would map into the slot 5 area in the drop 2 image in the master as follows. In this example, registers 1-31 are not used.

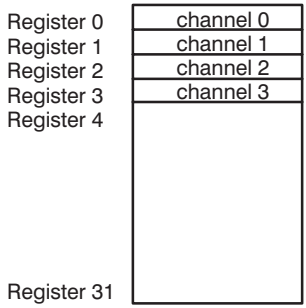
Slot 5 Area in Drop 2 Image



Example #2

A four-channel analog output module in slot 9 of drop 4 would map into the slot 9 area in the drop 4 image in the master as follows. In this example, registers 4-31 are not used.

Slot 9 Area in Drop 4 Image



Appendix I
(Continued)

Remote I/O Head Drop (M/N 57C330)

In the master Remote I/O module, the image area for each Remote I/O Head drop is subdivided into 4 areas, one for each port on the Remote I/O Head. Each port on the Remote I/O Head is treated like a slot for memory mapping purposes. Ports are numbered 0 through 3, which would correspond to slots 0 through 3. Each “slot” image contains four 16-bit registers. The Remote I/O Head can connect Digital I/O Rails, Local I/O Heads, and Analog Rail I/O modules to the remote I/O network as described below.

Remote I/O Head Drop Restrictions (per drop):

Maximum number of input registers: 16

Maximum number of output registers: 16

Input and output modules must not be mixed within a Digital I/O Rail connected to the Remote I/O Head.

Remote I/O Head Drop (M/N 57C328)

In the master Remote I/O module, the image area for each Remote I/O Head drop is subdivided into 4 areas, one for each port on the Remote I/O Head. Each port on the Remote I/O Head is treated like a slot for memory mapping purposes. Ports are numbered 0 through 3, which would correspond to slots 0 through 3. Each “slot” image contains eight 16-bit registers. Four registers (0-3) are dedicated for input data, and four registers (4-7) are dedicated to output data. You cannot access registers 8-31. These registers are divided into pairs for the input and output data of each of the four possible rails per port. Input/output bits are loaded into the registers according a module’s position in the rail.

The Remote I/O Head can connect Digital I/O Rails, Local I/O Heads, and Analog I/O Rail modules to the remote I/O network as described below.

Remote I/O Head Drop Restrictions (per drop):

Maximum number of input registers: 16

Maximum number of output registers: 16

Input and output modules can be mixed within a Digital I/O Rail connected to the Remote I/O Head.

Appendix I
(Continued)

AutoMate Digital I/O Rail (M/N 45C1)

The Digital I/O Rail can contain up to eight two-point digital input or output modules. When the Rail is connected to a M/N 57C330 Remote I/O Head, these modules map as bits 0 through 15 in register 0 of the corresponding port (slot image) in the master. For example, if a Digital I/O Rail were connected to port 2 (treated like slot 2) of an M/N 57C330 Remote I/O Head designated as drop 5, the I/O in the Rail would be mapped as follows. In this example, registers 1-3 are not used.

Slot 2 Area in Drop 5 Image

Register 0	16 bits
Register 1	no access
Register 2	no access
Register 3	no access

When the Rail is connected to an M/N 57C328 Remote I/O Head, the input modules map as bits 0 through 15 in register 0 and the output modules map as bit 0 through 15 in register 4 of the corresponding port (slot image) in the master. For example, if the Digital I/O Rail mentioned above were connected to an M/N 57C328 Remote I/O Head, the I/O in the Rail would be mapped as follows:

Slot 2 Area in Drop 5 Image

Register 0	16 bits for inputs
Register 1	no access
Register 2	no access
Register 3	no access
Register 4	16 bits for output
Register 5	no access
Register 6	no access
Register 7	no access

Local I/O Head (M/N 61C22, M/N 61C23)

The Local I/O Head has four ports, each of which can be connected to an AutoMate Digital I/O Rail. As described above, each Digital I/O Rail can contain up to eight 2-point input or output modules. If a Local I/O Head with a Digital I/O Rail on each of its four ports were connected to port 3 (i.e., slot 3) of the M/N 57C330 Remote I/O Head designated as drop 7, the I/O would be mapped as follows:

Slot 3 Area in Drop 7 Image

Register 0	LIO Head port 0 Rail
Register 1	LIO Head port 1 Rail
Register 2	LIO Head port 2 Rail
Register 3	LIO Head port 3 Rail

Appendix I
(Continued)

If the Local I/O Rail mentioned above were connected to a M/N 57C328 Remote I/O Head, the I/O in the Rails would be mapped as follows:

Slot 3 Area in Drop 7 Image

Register 0	LIO Head port 0 Rail Inputs
Register 1	LIO Head port 1 Rail Inputs
Register 2	LIO Head port 2 Rail Inputs
Register 3	LIO Head port 3 Rail Inputs
Register 4	LIO Head port 0 Rail Outputs
Register 5	LIO Head port 1 Rail Outputs
Register 6	LIO Head port 2 Rail Outputs
Register 7	LIO Head port 3 Rail Outputs

Analog Rail I/O Module (various models)

An Analog Rail I/O module connected to a Remote I/O Head provides four input or output analog signals, depending upon the module selected. For example, if a Four-Channel Analog Rail Output module were connected to port 3 of an M/N 57C330 Remote I/O Head designated as drop 2, the outputs would be mapped as follows:

Slot 3 Area in Drop 2 Image

Register 0	Channel 0 Data
Register 1	Channel 1 Data
Register 2	Channel 2 Data
Register 3	Channel 3 Data

If the Analog I/O Rail Output module mentioned above were connected to an M/N 57C328 Remote I/O Head, the outputs would be mapped as follows:

Slot 3 Area in Drop 2 Image

Register 0	Channel 0 Input Data
Register 1	Channel 1 Input Data
Register 2	Channel 2 Input Data
Register 3	Channel 3 Input Data
Register 4	Channel 0 Output Data
Register 5	Channel 1 Output Data
Register 6	Channel 2 Output Data
Register 7	Channel 3 Output Data

Appendix I (Continued)

AutoMax Thumbwheel Switch and LED Modules

Note: AutoMate Thumbwheel Switch (M/N 45C630) and LED modules (45C631) require an I/O port on the Remote I/O Head or on a Local I/O Head. Both modules are mapped as if they were actually Digital I/O Rails, with each digit on the Thumbwheel Switch and LED Module mapped using BCD (binary coded decimal) notation. For example, to display the number “7493” on an LED module connected to port 2 of the Local I/O Head, that is in turn connected to port 3 of an M/N 57C330 Remote I/O Head designated as drop 5, you would write the following value where indicated. In this example, registers 0, 1, and 3 are not used.

Slot 3 Area in Drop 5 Image

Register 0	no access
Register 1	no access
Register 2	0111 0100 1001 0011
Register 3	no access

If an LED module were connected to port 2 of a Local I/O Head that is connected in turn to port 3 of an M/N 57C328 Remote I/O Head designated as drop 5, you would write the following value BCD value where indicated to display the number “7463” on the LED module:

Slot 3 Area in Drop 5 Image

Register 0	no access
Register 1	no access
Register 2	LED input data
Register 3	no access
Register 4	no access
Register 5	no access
Register 6	0111 0100 1001 011
Register 7	no access

Appendix I
(Continued)

Remote Drive Interface Head Drops

In the master Remote I/O module, the image area for each Remote Drive Interface Head drop is divided into four areas, one for each port on the Remote Drive Interface Head. Each port on the Remote Drive Interface Head is treated like a slot for memory mapping purposes. Ports are numbered 0 through 3, which would correspond to slots 0 through 3. Each “slot” image contains four 16-bit registers. The Remote Drive interface Head can connect up to four drives with rail-type interface ports (e.g., the Reliance V★S GP2000/VTAC V controller with a Rail Interface Card (1SC4000)) to the Remote I/O network. **The AutoMax Remote Drive Interface Head must not be connected to Local Heads, digital rails, or analog rails.**

The Remote Drive Interface Head uses a fixed configuration of two input registers and two output registers per I/O port. The Head assumes that the first two registers (0 and 1) are outputs (information to the drive) and the second two registers (2 and 3) are inputs (information from the drive). This configuration can not be changed. See the table below.

Memory Map(1)

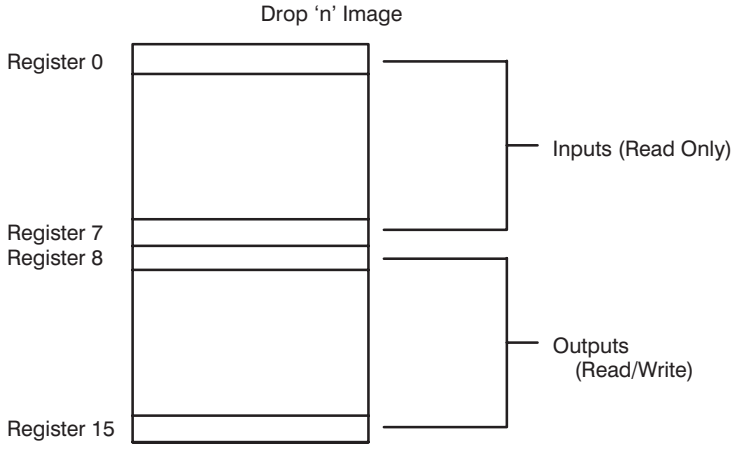
Register	Access from AutoMax Processor	Register Description
0	Read/Write	Drive Control Register
1	Read/Write	Drive Speed Reference in Hz (scaled x10)
2	Read Only	Drive Status Register
3	Read Only	Drive Feedback in Output Frequency (Hz), Output Voltage (VAC), or Output Current (% Amps)

(1) This table is applicable to the GP2000/VTAC V controller. Refer to instruction manual D2-3170 for a detailed bit mapping of these registers.

Appendix I (Continued)

Shark Remote I/O Racks

In the master Remote I/O module, the image area for each Shark drop is subdivided into 11 slots, with one slot (slot 0) reserved for the Shark Interface module, which must always be installed to the immediate right of the power supply in the rack. Each slot area is subdivided into sixteen 16-bit registers, the first eight of which are reserved for inputs, and the second eight for outputs as shown below. Examples of the memory mapping for specific types of Shark I/O modules are given on the following pages. Note that for slot 0, i.e. the Shark Interface module, register 0 is used for the configuration word only (if required). Registers 1-15 are not used.



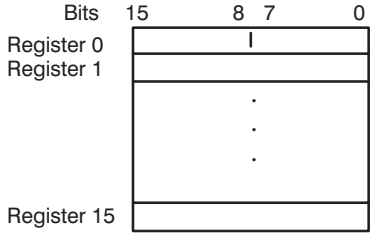
Note that word data (numeric data) in Shark modules is organized as high byte in the low address and low byte in the high address. The AutoMax Processor module in the master rack expects word data to be ordered so that the high byte of the word is in the high address and the low byte of the word is in the low address. This requires the Shark Interface module to swap the byte order when reading data from numeric (analog) modules in the Shark rack. The data appears in the correct format in the master Remote I/O module dual port. Data from digital Shark modules is not affected.

The byte swapping process is transparent to the user. It requires no application programming. The Variable Configurator screens in the AutoMax Programming Executive software V3.2 and later display the registers in Shark numeric modules in the byte swapped order. If you are using AutoMax Programming Executive V2.1 or earlier, the statements in the configuration task must define the data as it will appear in the master Remote I/O dual port.

Shark Remote I/O Drop Restrictions (per drop):
- Maximum number of input registers: 80
- Maximum number of output registers: 80

Appendix I
(Continued)

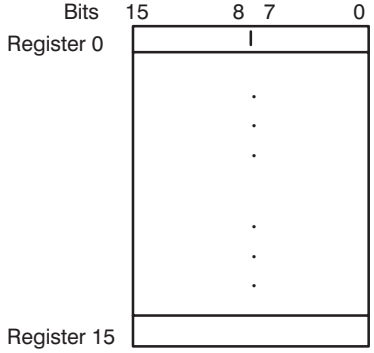
Typical 8-Channel Digital Input Module
Ex: M/N 45C940



Register 0 Bit 0 = Input 0
Bit 1 = Input 1
Bit 2 = Input 2
Bit 3 = Input 3
Bit 4 = Input 4
Bit 5 = Input 5
Bit 6 = Input 6
Bit 7 = Input 7
Bits 8-15 = 0

Register 0 is Read Only and is reserved for inputs. The register is bit-addressable. Only bits 0 to 7 are used to display the status of the eight inputs. Bits 8 to 15 are kept equal to zero.

Typical 16-Channel Digital Input Module
Ex: M/N 45C941

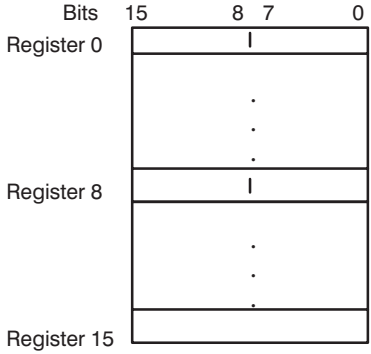


Register 0 Bit 0 = Input 0
Bit 1 = Input 1
Bit 2 = Input 2
Bit 3 = Input 3
Bit 4 = Input 4
Bit 5 = Input 5
Bit 6 = Input 6
Bit 7 = Input 7
Bit 8 = Input 8
Bit 9 = Input 9
Bit 10 = Input 10
Bit 11 = Input 11
Bit 12 = Input 12
Bit 13 = Input 13
Bit 14 = Input 14
Bit 15 = Input 15

Register 0 is Read Only and is reserved for inputs. The register is bit-addressable. Bits 0 to 15 are used to display the status of the sixteen inputs.

Appendix I
(Continued)

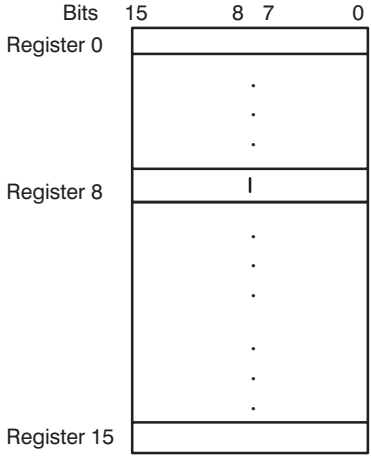
Typical 8-Channel Digital Output Module
Ex: M/N 45C960 and 45C968



Register 8: Bit 0 = Output 0
Bit 1 = Output 1
Bit 2 = Output 2
Bit 3 = Output 3
Bit 4 = Output 4
Bit 5 = Output 5
Bit 6 = Output 6
Bit 7 = Output 7

Register 8 is Read/Write and is reserved for outputs. The register is bit-addressable. Only bits 0 to 7 are used.

Typical 16-Channel Digital Output Module
Ex: M/N 45C959

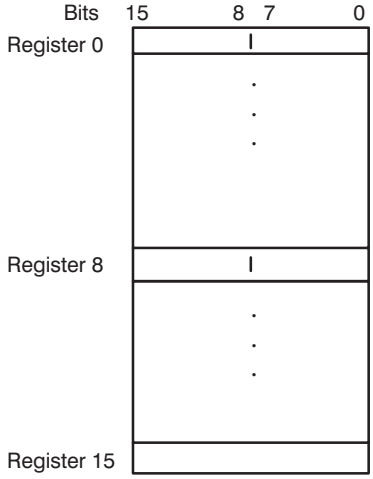


Register 8: Bit 0 = Output 0
Bit 1 = Output 1
Bit 2 = Output 2
Bit 3 = Output 3
Bit 4 = Output 4
Bit 5 = Output 5
Bit 6 = Output 6
Bit 7 = Output 7
Bit 8 = Output 8
Bit 9 = Output 9
Bit 10 = Output 10
Bit 11 = Output 11
Bit 12 = Output 12
Bit 13 = Output 13
Bit 14 = Output 14
Bit 15 = Output 15

Register 8 is Read/Write and is reserved for outputs. The register is bit-addressable. Bits 0 to 15 are used.

Appendix I
(Continued)

Typical 8-Channel Digital Output Module
Ex: M/N 45C958



Register 0: Bit 0 = Input 0
Bit 1 = Input 1
Bit 2 = Input 2
Bit 3 = Input 3
Bit 4 = Input 4
Bit 5 = Input 5
Bit 6 = Input 6
Bit 7 = Input 7
Bits 8-15 = 0

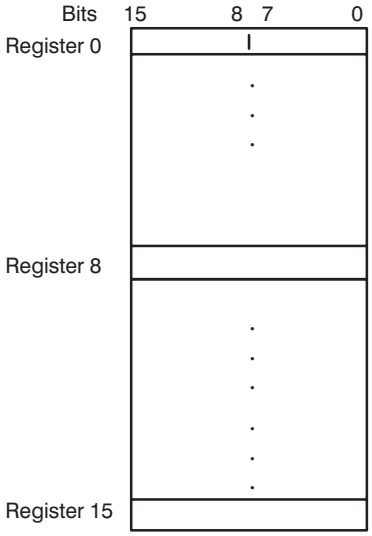
Register 8: Bit 8 = Output 8
Bit 9 = Output 9
Bit 10 = Output 10
Bit 11 = Output 11
Bit 12 = Output 12
Bit 13 = Output 13
Bit 14 = Output 14
Bit 15 = Output 15

Register 0 is Read Only and is reserved for inputs. The register is bit-addressable. Only bits 0 to 7 are used. Bits 8 to 15 are not used.

Register 8 is Read/Write and is reserved for outputs. The register is bit-oriented. Only bits 8 to 15 are used to display the status of the eight outputs. Bits 0 to 7 are kept equal to zero.

Appendix I
(Continued)

Typical 16-Channel Digital Input/Output Module
Ex: M/N 45C957

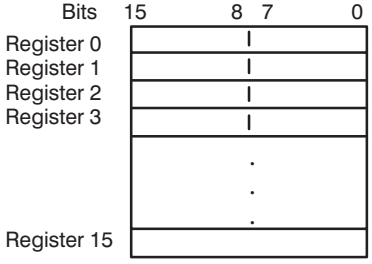


Register 0: Bit 0 = Input 0
Bit 1 = Input 1
Bit 2 = Input 2
Bit 3 = Input 3
Bit 4 = Input 4
Bit 5 = Input 5
Bit 6 = Input 6
Bit 7 = Input 7
Bit 8 = Input 8
Bit 9 = Input 9
Bit 10 = Input 10
Bit 11 = Input 11
Bit 12 = Input 12
Bit 13 = Input 13
Bit 14 = Input 14
Bit 15 = Input 15

Register 8: Bit 0 = Output 0
Bit 1 = Output 1
Bit 2 = Output 2
Bit 3 = Output 3
Bit 4 = Output 4
Bit 5 = Output 5
Bit 6 = Output 6
Bit 7 = Output 7
Bit 8 = Output 8
Bit 9 = Output 9
Bit 10 = Output 10
Bit 11 = Output 11
Bit 12 = Output 12
Bit 13 = Output 13
Bit 14 = Output 14
Bit 15 = Output 15

Register 0 is Read Only and is reserved for inputs. The register is bit-addressable. Bits 0 to 15 are used. Register 8 is Read/Write and is reserved for outputs. The register is bit addressable. Bits 0 to 15 are used.

Typical 4-Channel Analog Input Module
Ex: M/N 45CRTD



Register 0: Bits 0-7 = Input 0
Bits 8-15 = 0

Register 1: Bits 0-7 = Input 1
Bits 8-15 = 0

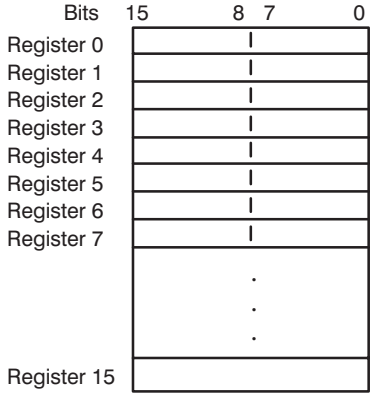
Register 2: Bits 0-7 = Input 2
Bits 8-15 = 0

Register 3: Bits 0-7 = Input 3
Bits 8-15 = 0

Registers 0 to 3 are Read Only and are reserved for inputs. The registers are word-addressable. Each register (bits 0 to 7) holds the value of one analog input. Bits 8 to 15 are not used.

Appendix I
(Continued)

Typical 8-Channel Analog Input Module
Ex: M/N 45C990



Register 0: Bits 0-7 = Input 0
Bits 8-15 = 0

Register 1: Bits 0-7 = Input 1
Bits 8-15 = 0

Register 2: Bits 0-7 = Input 2
Bits 8-15 = 0

Register 3: Bits 0-7 = Input 3
Bits 8-15 = 0

Register 4: Bits 0-7 = Input 4
Bits 8-15 = 0

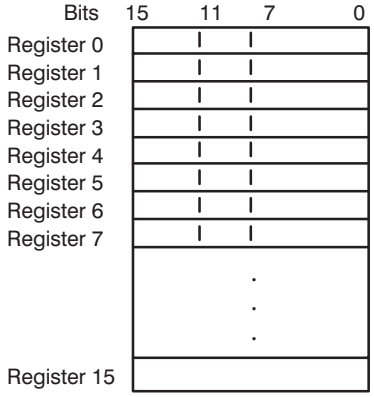
Register 5: Bits 0-7 = Input 5
Bits 8-15 = 0

Register 6: Bits 0-7 = Input 6
Bits 8-15 = 0

Register 7: Bits 0-7 = Input 7
Bits 8-15 = 0

Registers 0 to 7 are Read Only and are reserved for inputs. The registers are word-addressable. Each register (bits 0 to 7) holds the value of one analog input. Bits 8 to 15 are not used.

Typical 8-Channel High-Resolution Analog Input Module
Ex: M/N 45C991



Register 0: Bits 0-11 = Input 0
Bits 12-15 = 0

Register 1: Bits 0-11 = Input 1
Bits 12-15 = 0

Register 2: Bits 0-11 = Input 2
Bits 12-15 = 0

Register 3: Bits 0-11 = Input 3
Bits 12-15 = 0

Register 4: Bits 0-11 = Input 4
Bits 12-15 = 0

Register 5: Bits 0-11 = Input 5
Bits 12-15 = 0

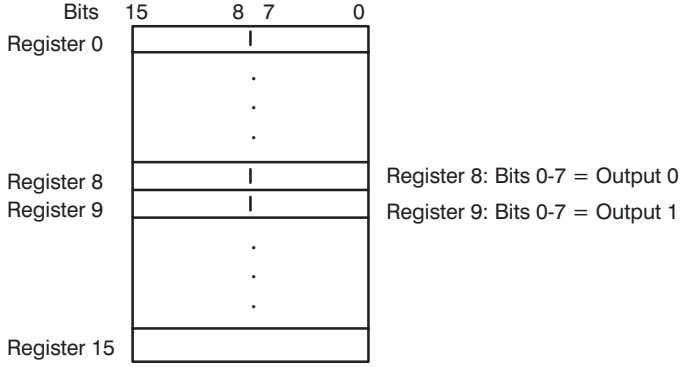
Register 6: Bits 0-11 = Input 6
Bits 12-15 = 0

Register 7: Bits 0-11 = Input 7
Bits 12-15 = 0

Registers 0 to 7 are Read Only and are reserved for inputs. The registers are word-addressable. Each register (bits 0 to 11) holds the value of one analog input. Bits 12 to 15 are not used.

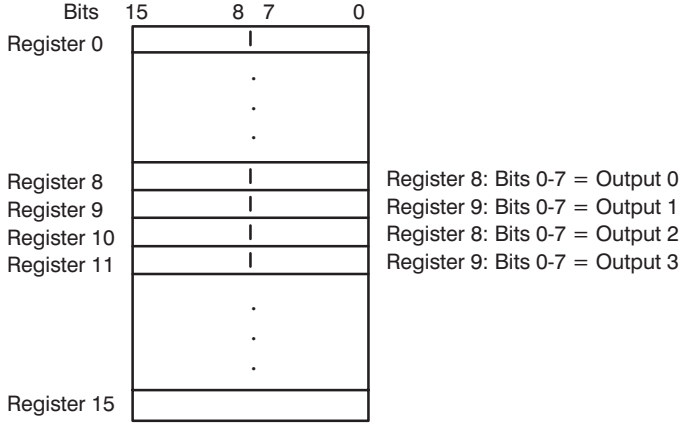
Appendix I
(Continued)

Typical 2-Channel Analog Output Module
Ex: M/N 45C993



Registers 8 and 9 are Read/Write and are reserved for outputs. The registers are word-addressable. Each register (bits 0 to 7) holds the value of one analog output. Bits 8 to 15 are not used.

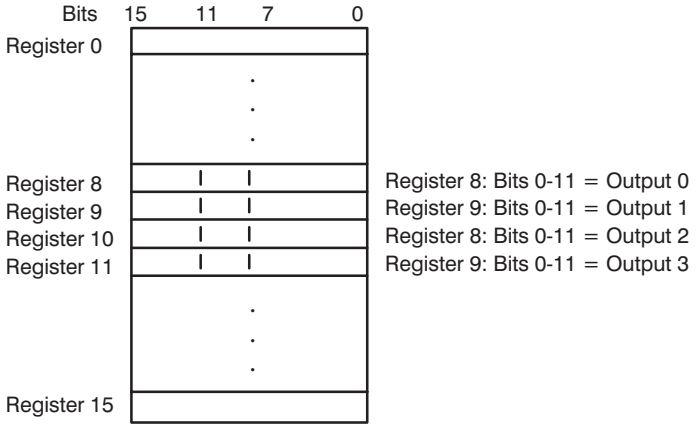
Typical 4-Channel Analog Output Module
Ex: M/N 45C995



Registers 8, 9, 10, and 11 are Read/Write and are reserved for outputs. The registers are word-addressable. Each register (bits 0 to 7) holds the value of one analog output. Bits 8 to 15 are not used.

Appendix I
(Continued)

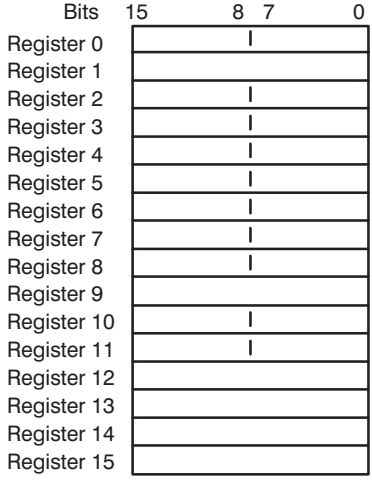
Typical 4-Channel High-Resolution Analog Output Module
Ex: M/N 45C998



Registers 8, 9, 10, and 11 are Read/Write and are reserved for outputs. The registers are word-addressable. Each register (bits 0 to 11) holds the value of one analog output.

Appendix I (Continued)

Typical Counter Module
Ex: M/N 45C982

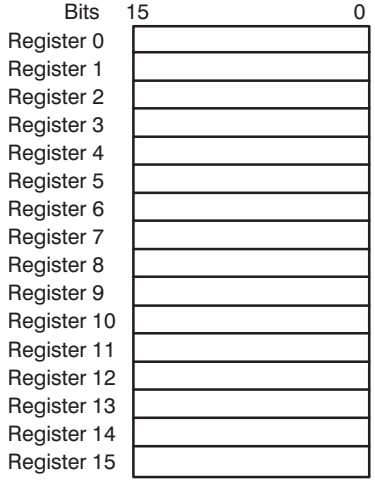


Reg 0: Bit 0 = Input B Status
Reg 0: Bit 7 = Underflow Flag
Reg 0: Bit 8 = Input A Status
Reg 0: Bit 15 = Overflow Flag
Reg 1: Current Counter Value
Reg 2: Bit 7 = CPE Flag
Reg 2: Bit 15 = MCE Flag
Reg 3: Bit 7 = 1-Phase/2-Phase
Reg 3: Bit 15 = Input M Status
Reg 4: Bit 7 = Counter 0 > Flag
Reg 4: Bit 15 = Counter 0 = Flag
Reg 5: Bit 7 = Counter 1 > Flag
Reg 5: Bit 15 = Counter 1 = Flag
Reg 6: Bit 7 = Counter 2 > Flag
Reg 6: Bit 15 = Counter 2 = Flag
Reg 7: Bit 7 = Counter 3 > Flag
Reg 7: Bit 15 = Counter 3 = Flag
Reg 8: Bit 0 = Counter Preset
Reg 8: Bit 7 = Underflow Clear
Reg 8: Bit 8 = Marker Enable
Reg 8: Bit 9 = Counter Enable
Reg 8: Bit 10 = All Clear
Reg 8: Bit 11 = Clear 0 = Flag
Reg 8: Bit 12 = Clear 1 = Flag
Reg 8: Bit 13 = Clear 2 = Flag
Reg 8: Bit 14 = Clear 3 = Flag
Reg 8: Bit 15 = Overflow Clear
Reg 9: Counter Preset Value
Reg 10: Bit 0 = Forced Output 0
Reg 10: Bit 1 = Forced Output 1
Reg 10: Bit 2 = Forced Output 2
Reg 10: Bit 3 = Forced Output 3
Reg 10: Bit 7 = Output 1 Control
Reg 10: Bit 8 = Forced Out 0 En.
Reg 10: Bit 9 = Forced Out 1 En.
Reg 10: Bit 10 = Forced Out 2 En
Reg 10: Bit 11 = Forced Out 3 En
Reg 10: Bit 15 = Output 0 Control
Reg 11: Bit 7 = Output 3 Control
Reg 11: Bit 15 = Output 2 Control
Reg 12: Counter 0 Preset Value
Reg 13: Counter 1 Preset Value
Reg 14: Counter 2 Preset Value
Reg 15: Counter 3 Preset Value

Registers 0 through 7 are Read Only and are reserved for inputs. Registers 8 through 15 are Read/Write and are reserved for outputs.

Appendix I
(Continued)

Typical ASCII Module
Ex: M/N HEC-ABM-222



Register 0: Bits 0-15 = ASCII In
Register 1: Bits 0-15 = ASCII In
Register 2: Bits 0-15 = ASCII In
Register 3: Bits 0-15 = ASCII In
Register 4: Bits 0-15 = ASCII In
Register 5: Bits 0-15 = ASCII In
Register 6: Bits 0-15 = ASCII In
Register 7: Bits 0-15 = ASCII In

Register 8: Bits 0-15 = ASCII Out
Register 9: Bits 0-15 = ASCII Out
Register 10: Bits 0-15 = ASCII Out
Register 11: Bits 0-15 = ASCII Out
Register 12: Bits 0-15 = ASCII Out
Register 13: Bits 0-15 = ASCII Out
Register 14: Bits 0-15 = ASCII Out
Register 15: Bits 0-15 = ASCII Out

Registers 0 to 7 are Read Only and are reserved for ASCII input values. The registers are word-addressable.

Registers 8 to 15 are Read/Write and are reserved for ASCII output values. The registers are word-addressable.