SERIESTHREE

PROGRAMMABLE CONTROLLER

SUPPLEMENT TO THE SERIES THREE MANUAL

GEK-90819

AUGUST 1984

GENERAL ⊛ ELECTRIC

Warning, Caution, and Notes As Used In This Publication

WARNING

Warning notices are used in this publication to emphasize that hazardous voltages, currents, temperatures, or other conditions that could cause personal injury exist in this equipment.

CAUTION

Caution notices are used where equipment might be damaged if care is not taken.

In situations where inattention could cause either personal injury or damage to equipment, a Warning notice is used.

NOTE

Notes merely call attention to information that is especially significant in understanding and operating the equipment.

TABLE OF CONTENTS

INTRODUCTION

The bulletins listed in this table of contents contain new product information concerning the Series Three Programmable Controller. This supplement is provided for your convenience. This information will be included in the next update of the Series Three Manual, GEK-25376.

SERIES
ONE/THREE/SIX
BULLETIN

GENERAL ⚡ ELECTRIC

PROGRAMMABLE
CONTROL
DEPARTMENT

PRODUCT: Series Three

CATEGORY: Product Information

SUBJECT: High Speed Counter User Guide

AUTHOR: J. C. Hamby

3A-001
April 6, 1984

A.   **GENERAL DESCRIPTION**

The High Speed Counter module (HSC) allows the Series Three to monitor and control a variety of Process Variables (Position, Velocity, Flow Rate) that the CPU cannot accomodate due to timing constraints. A direction sensing encoder is used to interface the module's counter with the process variable. Encoders of this type represent clockwise and counterclockwise motion with two separate pulse trains which increment and decrement the current value of the counter.

Three open collector outputs are provided so that the module can react immediately when specific preset values are reached. To allow the operator to view the current value of the counter there is an optional four digit signed BCD output.

The module can be installed in any I/O slot, and uses 32 I/O references to interface with user logic.

SPECIFICATIONS

● EXTERNAL POWER REQUIREMENTS

BCD Output:	Voltage	5-12 VDC +10% -5%
	Current	5V, 8ma 12V, 16 ma
Three Discrete Counter Outputs:	Voltage	24 VDC ± 10%
Encoder:	Voltage	12 VDC ± 10%

● COUNTER CHARACTERISTICS

Three Inputs:	1. Incremental Pulse 2. Decremental Pulse 3. Reset/Marker Pulse
OFF State: ON State:	< 1 VDC, > 15 ma > 12 VDC $\pm 10\%$
Pulse Rate:	≤ 10 KHz
Range:	-9999 to +9999 Binary Coded Decimal (BCD)
Minimum Pulse Width:	25 microseconds
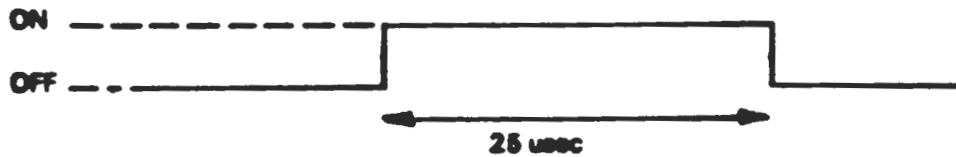
● COUNTER OUTPUT CHARACTERISTICS

Open Collector:	24 VDC ± 10% 300 ma Max/Output
Quanity:	3

● CURRENT COUNT OUTPUT

Format:	Four Digit Signed BCD
Current Sink	8 ma at 5 VDC 16 ma at 12 VDC
External Power Requirements:	5-12 VDC

● INTERFACE TO USER LOGIC

Quanity:	32 I/O References
Inputs:	Current Value of Counter < Preset Value = Preset Value > Preset Value Carry/Borrow Current Count Direction Current Count Sign Current Count Latch
Outputs:	Current Count Preset Output Mode Select Output State

● ENVIRONMENTAL

Operating Temperature:	0 - 60°C
Humidity:	5 - 95% Non Condensing

B. INTERFACE TO FIELD DEVICES

A 16 PIN (J1) and 24 PIN (J2) connector (Refer to Figures 1, 2, and 3) located on the face of the HSC serve as the interface between the module and its associated field devices which include:

1. Bidirectional incremental encoder with marker/reset pulse

2. Four digit signed binary coded decimal display

3. Three field devices under control of HSC's outputs

4. Current count latch switch

5. Load current count switch

HIGH SPEED
COUNTER

	I/O		I/O	I/O	I/O	I/O

SERIES THREE
C.P.U.

LATCH CURRENT
COUNT

LOAD CURRENT
COUNT

USER
LOADS

− +

RESET/MARKER

ENCODER

+ / −

4 DIGIT SIGNED
BCD DISPLAY
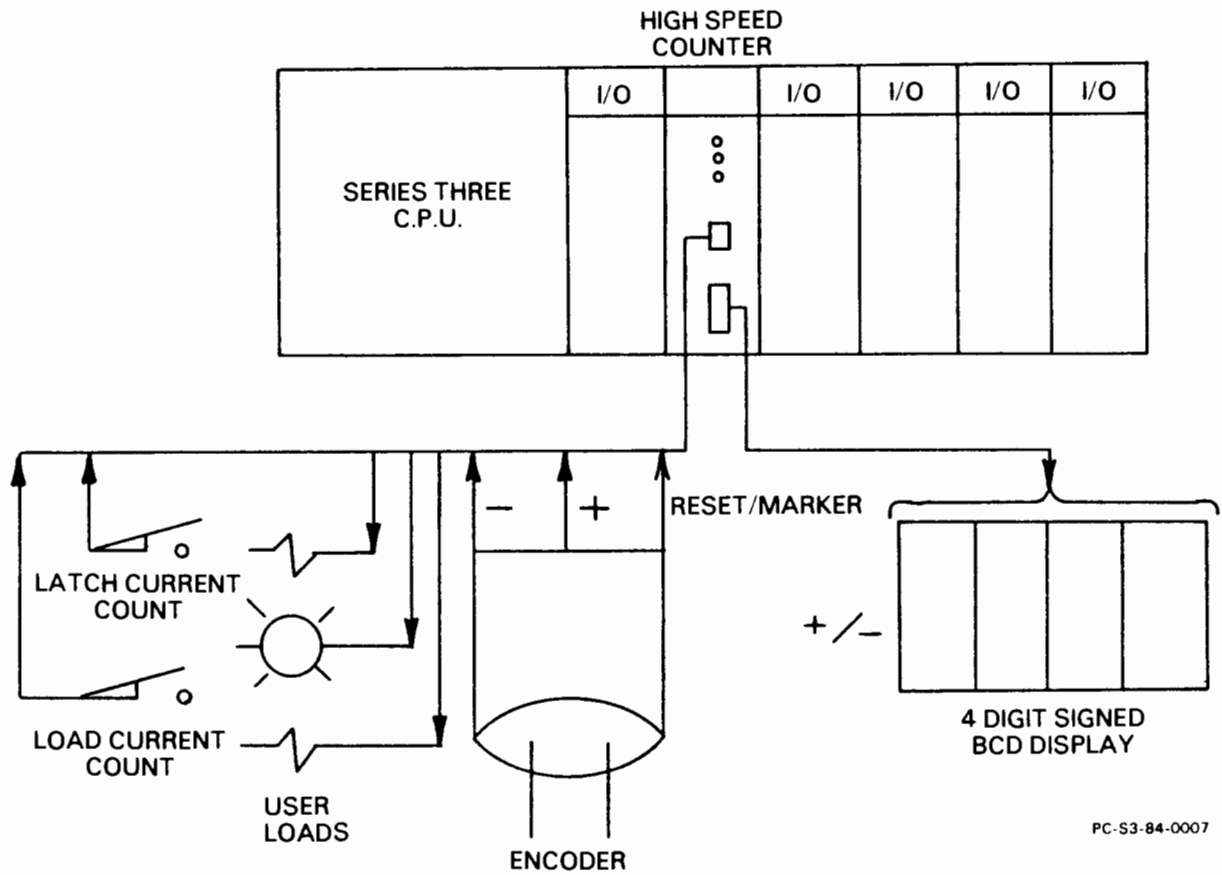
PC-S3-84-0007

Figure 1
HSC AND ITS ASSOCIATED FIELD DEVICES

A		B	

1 (BCD) ← ○ 1 ○ → 100 (BCD)

2 (BCD) ← ○ 2 ○ → 200 (BCD)

4 (BCD) ← ○ 3 ○ → 400 (BCD)

8 (BCD) ← ○ 4 ○ → 800 (BCD)

10 (BCD) ← ○ 5 ○ → 1000 (BCD)

20 (BCD) ← ○ 6 ○ → 2000 (BCD)

40 (BCD) ← ○ 7 ○ → 4000 (BCD)

80 (BCD) ← ○ 8 ○ → 8000 (BCD)

SIGN (+) ← ○ 9 ○ → (+) 5 - 12 VDC

← ○ 10 ○ →

(+) 5 - 12 VDC
+10%
-5%   ← ○ 11 ○ →   (-) 5 - 12 VDC
+10%
-5%

← ○ 12 ○ →

PC-S3-84-0008

Figure 2
PIN DEFINITION J2

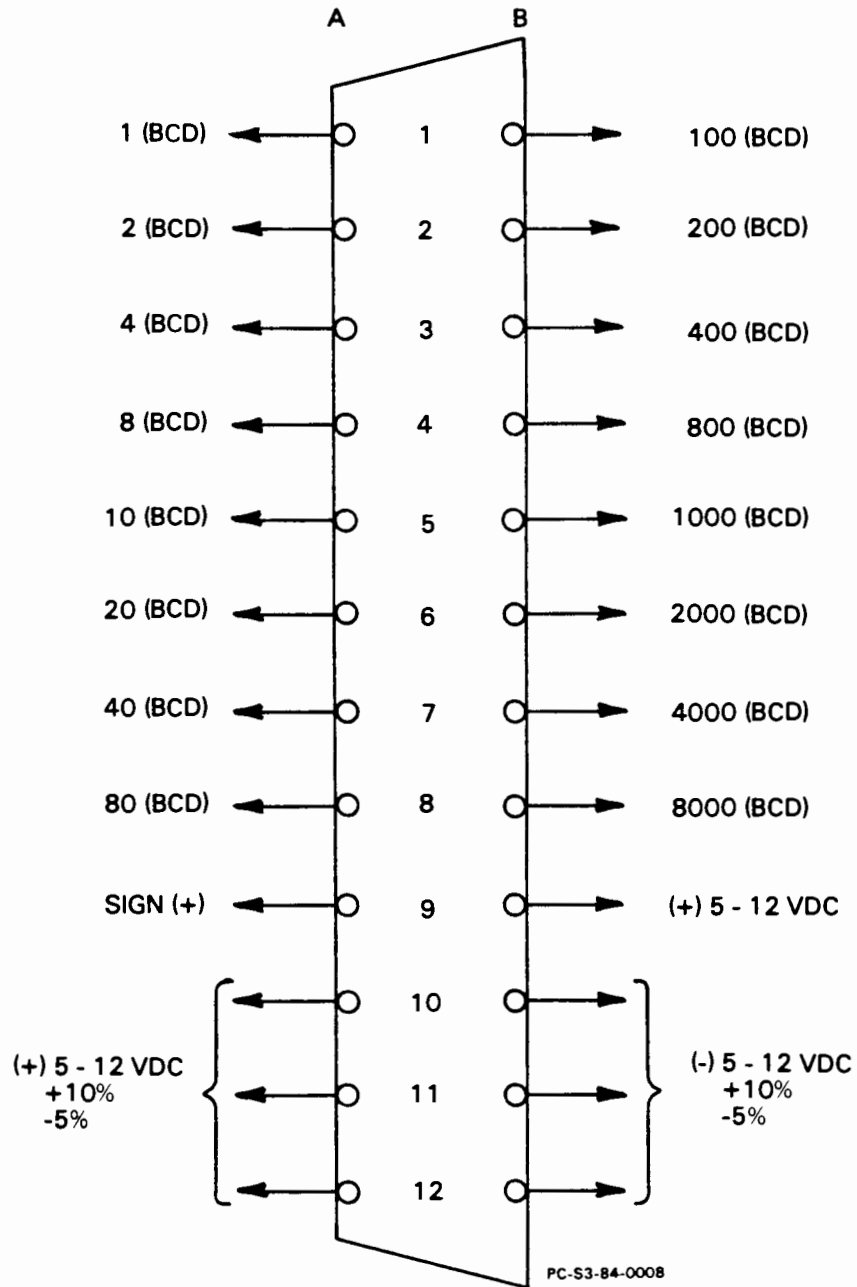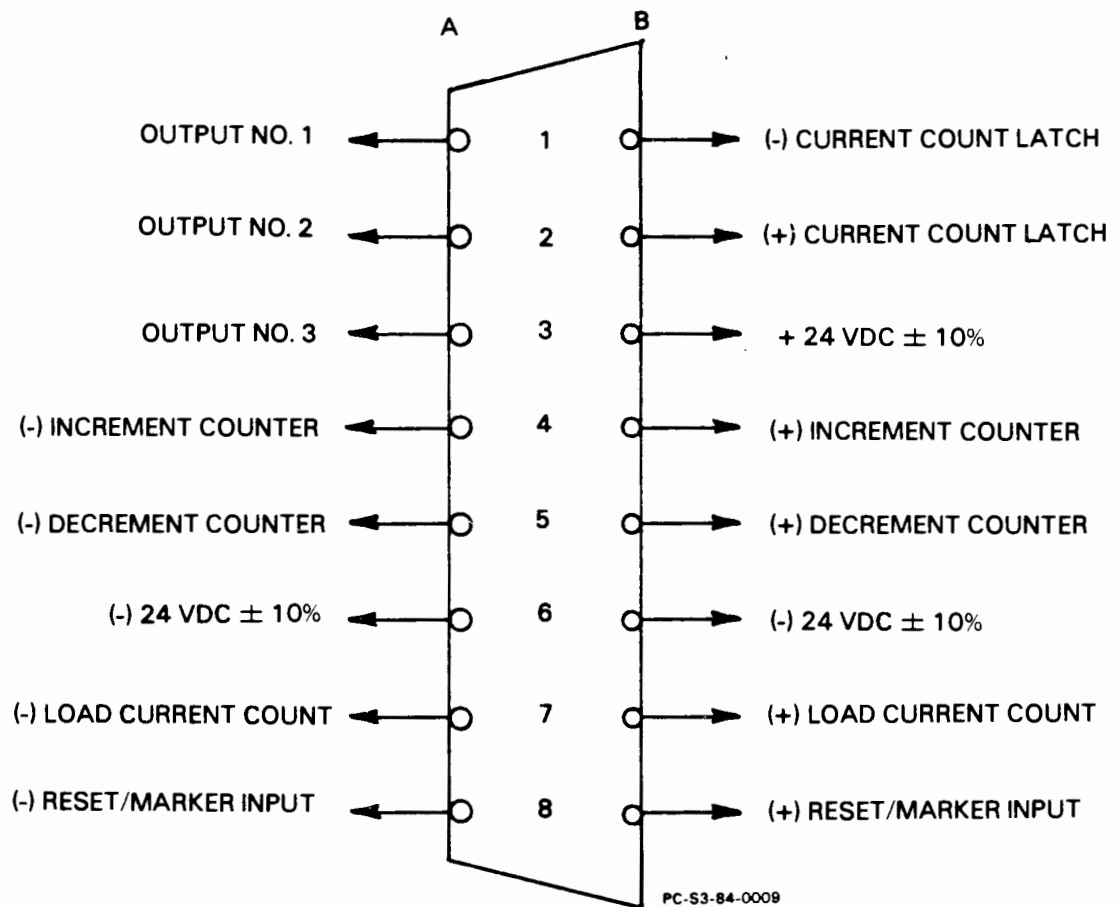|	A		B	
OUTPUT NO. 1 ←	○	1	○	→ (-) CURRENT COUNT LATCH
OUTPUT NO. 2 ←	○	2	○	→ (+) CURRENT COUNT LATCH
OUTPUT NO. 3 ←	○	3	○	→ + 24 VDC ± 10%
(-) INCREMENT COUNTER ←	○	4	○	→ (+) INCREMENT COUNTER
(-) DECREMENT COUNTER ←	○	5	○	→ (+) DECREMENT COUNTER
(-) 24 VDC ± 10% ←	○	6	○	→ (-) 24 VDC ± 10%
(-) LOAD CURRENT COUNT ←	○	7	○	→ (+) LOAD CURRENT COUNT
(-) RESET/MARKER INPUT ←	○	8	○	→ (+) RESET/MARKER INPUT

PC-S3-84-0009

Figure 3
PIN DEFINITION J1

The wiring configuration of each field device is addressed separately for clarity.

INCREMENTAL ENCODER

The Incremental Encoder utilizes three signals to control the current value of the counter. Two separate pulse trains which represent clockwise and counterclockwise movement increment and decrement the counter, while the reset/marker pulse sets it to zero. In many applications the reset/marker pulse will not come from the encoder, but from some sort of home switch. Shown in Figures 4, 5, and 6 are recommended encoder wiring configurations.
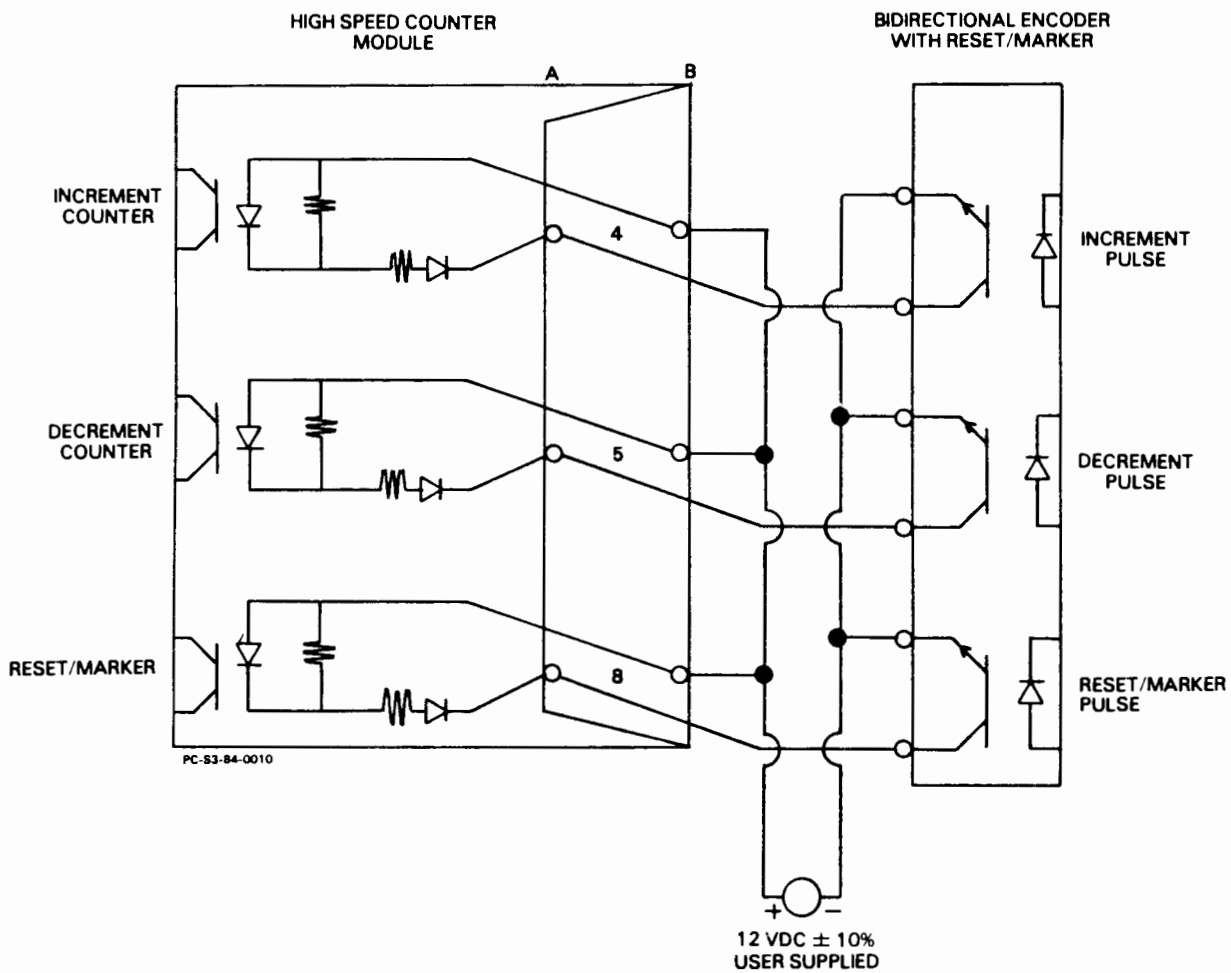
Figure 4
BIDIRECTIONAL ENCODER WITH RESET/MARKER PULSE

HIGH SPEED COUNTER
MODULE

BIDIRECTIONAL ENCODER
WITH RESET/MARKER

A   B

INCREMENT
COUNTER

4

INCREMENT
PULSE

DECREMENT
COUNTER

5

DECREMENT
PULSE

RESET/MARKER

8

RESET/MARKER
PULSE

PC-S3-84-0011

HOME SWITCH

12 VDC ± 10%
USER SUPPLIED
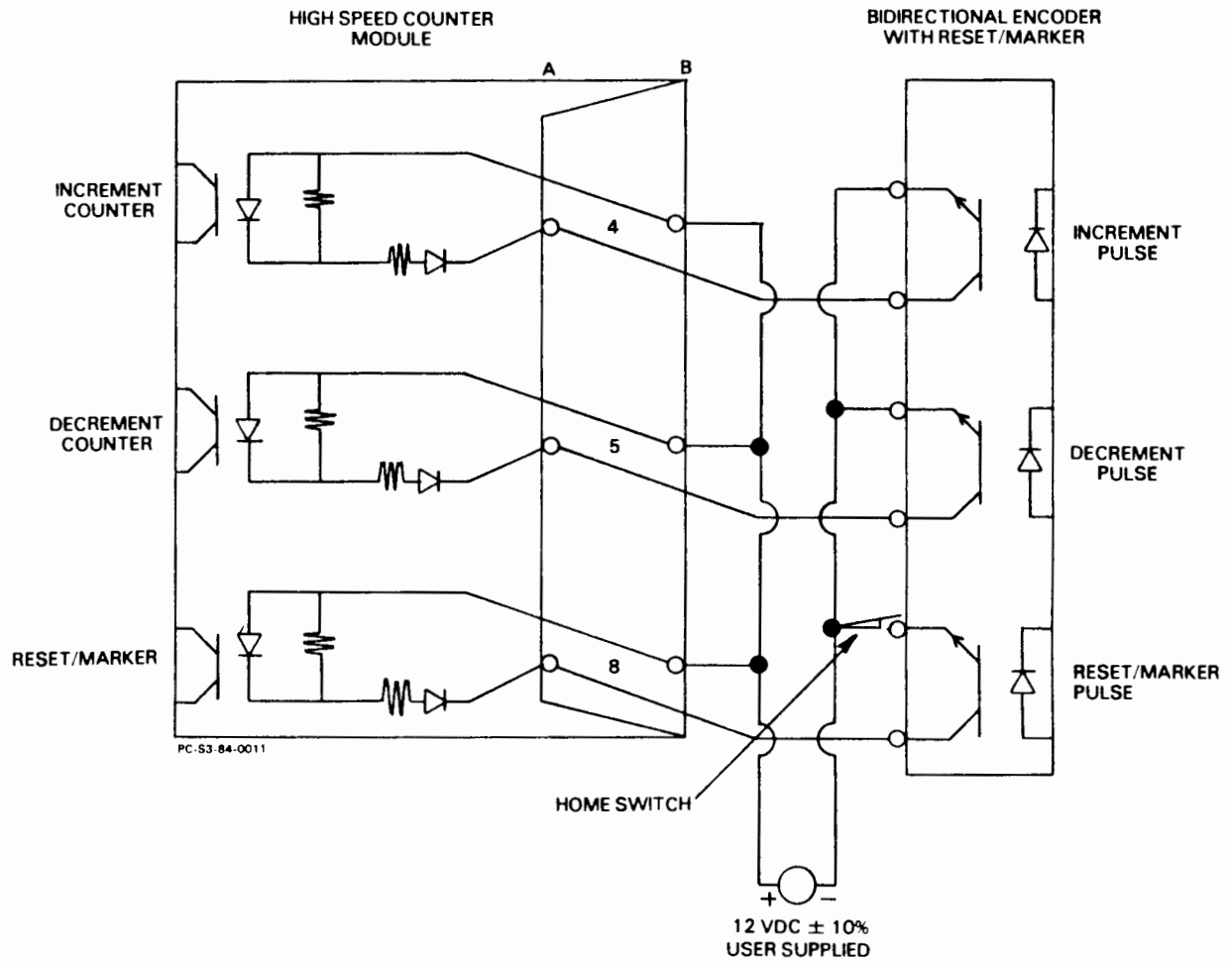
Figure 5
BIDIRECTIONAL ENCODER WITH HOME SWITCH RESET

HIGH SPEED COUNTER MODULE

A   B

INCREMENT
COUNTER

DECREMENT
COUNTER

RESET
COUNTER

4

5

8

PC-S3-B4-0012

DIODES ARE USER SUPPLIED

RESET LIMIT SWITCH

+12 VDC ± 10%
USER SUPPLIED

BIDIRECTIONAL
ENCODER

INCREMENT
PULSE

DECREMENT
PULSE

PHOTOELECTRIC*
CELL
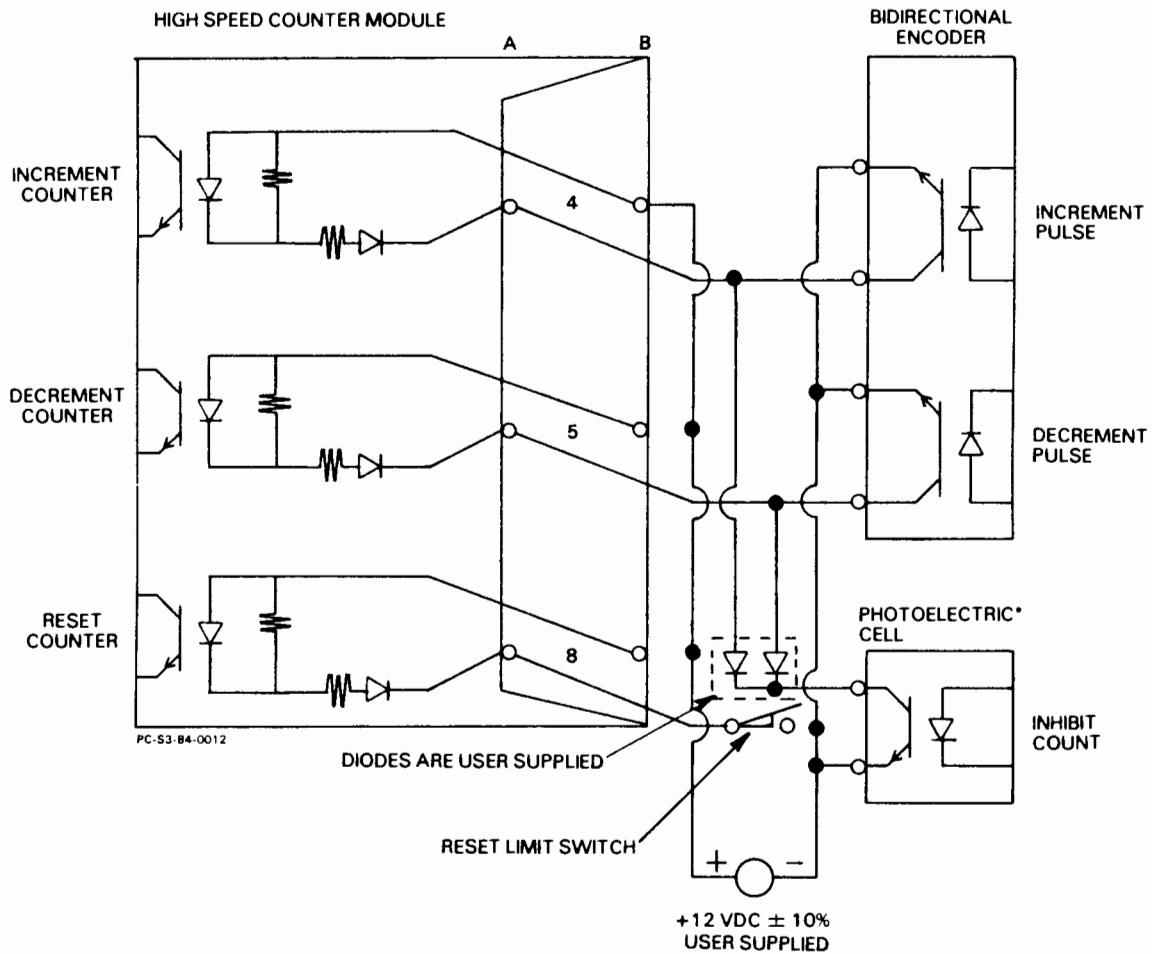
INHIBIT
COUNT

* SENSE OF PHOTOELECTRIC CELL
ON: COUNT INHIBITED
OFF: COUNT NOT INHIBITED

Figure 6
BIDIRECTIONAL ENCODER WITH LIMIT SWITCH RESETTING
COUNTER AND PHOTOELECTRIC CELL INHIBITING COUNT

BCD OUTPUT

The current value of the counter can be displayed via the module's four digit signed BCD output (Refer to Figure 7).
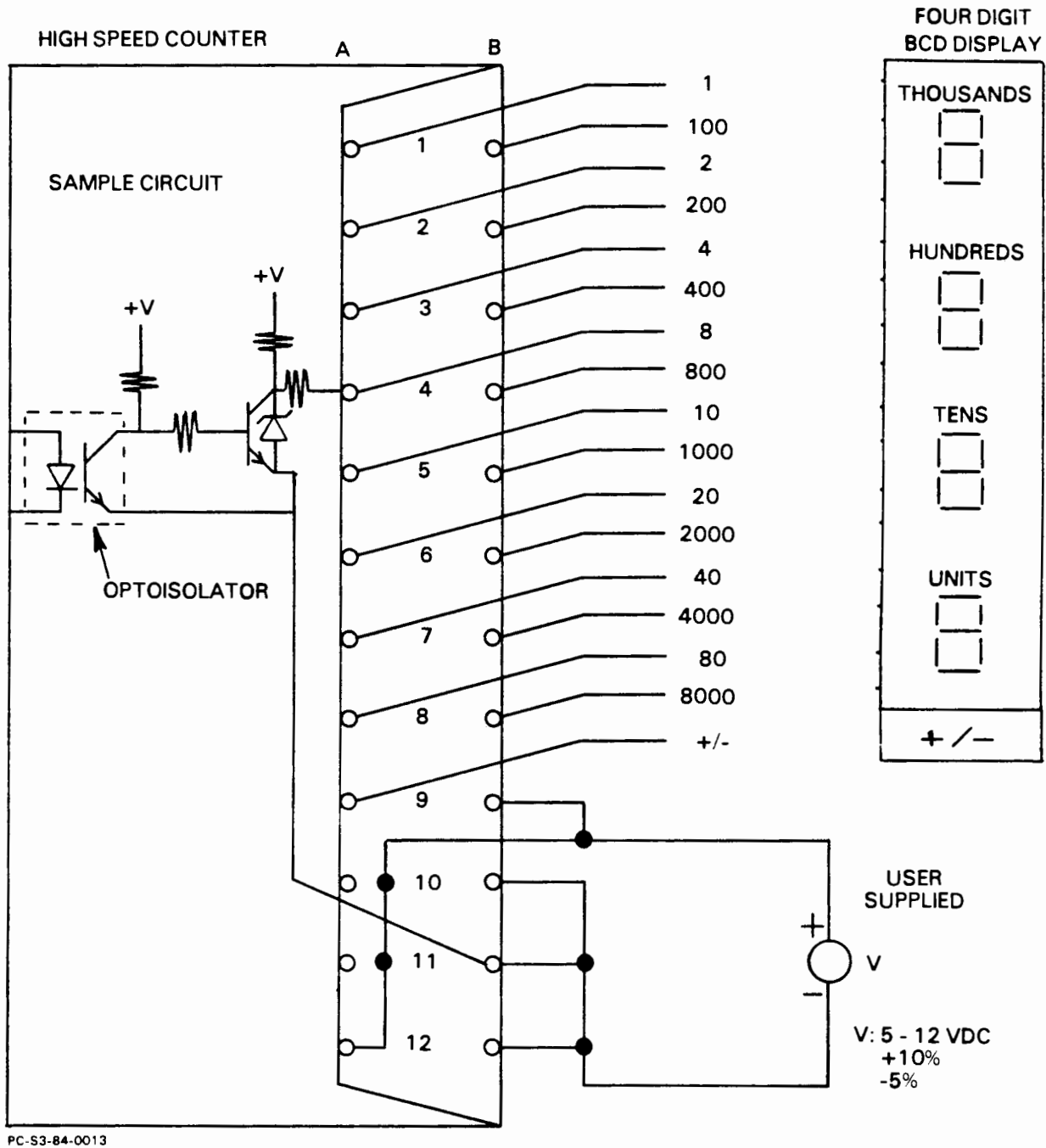

PC-S3-84-0013

Figure 7
BCD OUTPUT WIRING DIAGRAM

SENSE OF BCD OUTPUT:

OUTPUT	OPTOISOLATOR	OUTPUT VOLTAGE
0	OFF	OV DC
1	ON	+ V (12 V/5 VDC)

SENSE OF CURRENT COUNT SIGN (+/-)

SIGN	OPTOISOLATOR	OUTPUT VOLTAGE
+	OFF	$\approx$OV DC
-	ON	+V (12 V/5 VDC)

USER LOADS

To provide an immediate response when specific counter presets are reached, three open collector outputs are provided. The ON/OFF status of these outputs is determined by the comparison of the counters preset and current value. The wiring configuration of these outputs is shown in Figure 8.
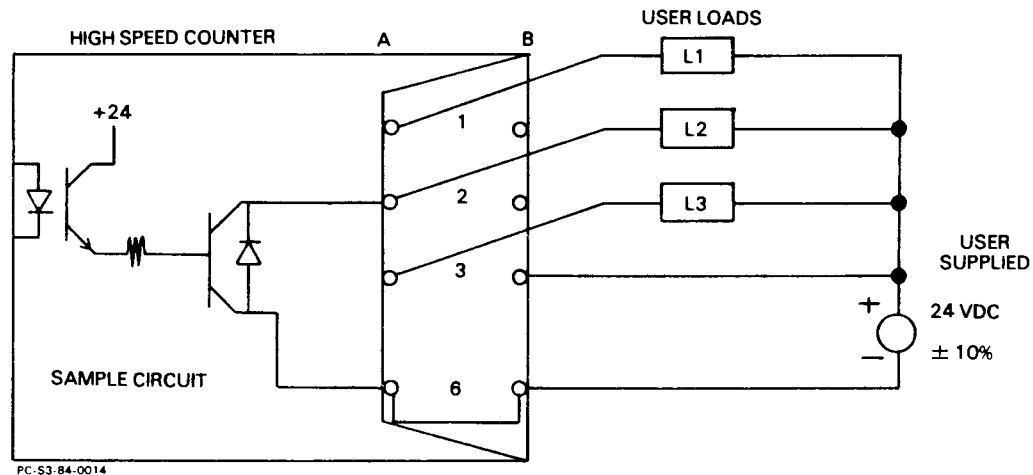

PC-S3-84-0014

Figure 8
USER LOAD WIRING DIAGRAM

CURRENT COUNT LATCH

By enabling the current count latch the current value of the HSC is "frozen" (latched) as far as the BCD output and User Logic are concerned. However, the HSC doesn't stop counting pulses, and when the latch is released the BCD output and user logic are updated with the current value of the counter. The physical wiring of this latch is shown in Figure 9.

PC-S3-84-0015
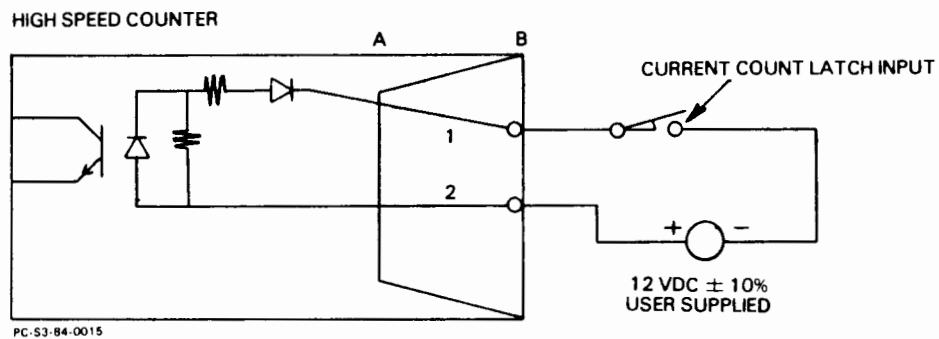
Figure 9
CURRENT COUNT LATCH WIRING DIAGRAM

CURRENT COUNT LOAD

The Current Count Load Input, when enabled will write the contents of HSC buffer into the current count (accumulate) register of the HSC (Refer to Interface to User Logic Section, Output References). This REAL WORLD Input is equivalent to output references 23 in the User Logic Interface. The wiring configuration of this input is shown in Figure 10.

PC-S3-84-0016

Figure 10
LOAD CURRENT COUNT WIRING DIAGRAM
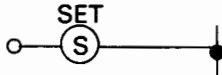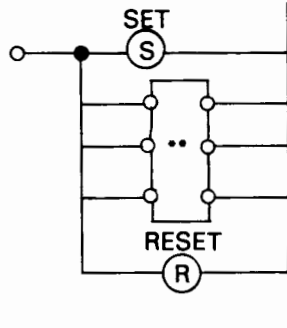
C.   INTERFACE TO USER LOGIC
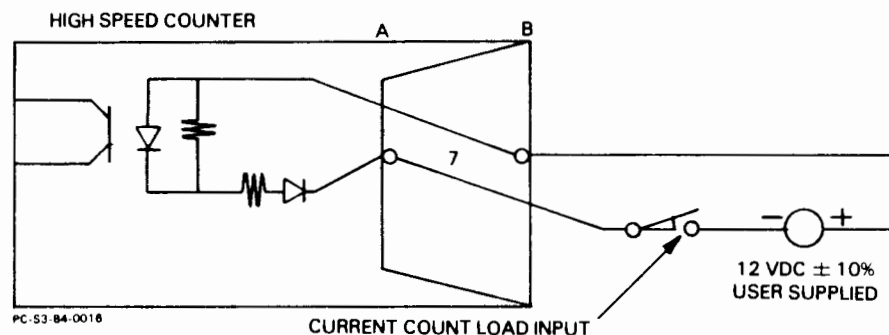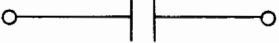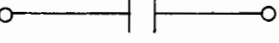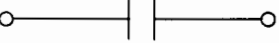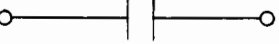
The HSC uses standard discrete ladder logic and data move instructions to interface with user logic. Information flows to and from the module through 32 I/O references. The actual I/O references used in an application program depend upon the location of the module in the I/O system. A number of these references act as both inputs and outputs depending on the function being implemented. The following chart defines the instructions associated with each I/O reference, and assumes the HSC is located directly adjacent to the Series Three CPU.

INPUT REFERENCE	USER LOGIC SYMBOL	INPUT FUNCTION DEFINITION
0-17	o——[D●STR]——●	[CURRENT COUNT] → [CPU ACCUMULATOR] WRITES CURRENT VALUE OF COUNTER TO ACCUMULATE REGISTER (4 DIGIT BCD)
20*	o———| |———o	≥ PRESET ENABLED WHEN CURRENT VALUE OF COUNTER IS GREATER THAN ITS PRESET VALUE
21*	o———| |———o	≤ PRESET ENABLED WHEN CURRENT VALUE OF COUNTER IS LESS THAN ITS PRESET VALUE
22*	o———| |———o	= PRESET ENABLED WHEN CURRENT VALUE OF COUNTER IS EQUAL TO ITS PRESET VALUE

*The status of Inputs 20, 21, and 22 are given to the User Logic once per scan. Therefore, if a particular condition is true for less than the scan time of the machine it's associated Input Reference wouldn't necessarily get enabled.

INPUT REFERENCE	USER LOGIC SYMBOL	INPUT FUNCTION DEFINITION
23	o———⊣ ⊢———o	CARRY/BORROW
		DEFINITION BELOW

CARRY/BORROW DEFINITION

Enabled when the current value of the counter undergoes one of the five sequences described below:

1. +9998 → +9999 → 0000 (Increment Rollover)

2. +0001 → 0000 → -0001 (Positive to Negative)

3. -0001 → 0000 → +0001 (Negative to Positive)

4. -9998 → -9999 → 0000 (Decrement Rollover)

5. (Current Count) → 0000 Via External Reset

24	o———⊣ ⊢———o	CURRENT COUNT DIRECTION
		ENABLED WHEN CURRENT VALUE OF COUNTER IS MOVING IN THE POSITIVE DIRECTION
25	o———⊣ ⊢———o	CURRENT COUNT SIGN
		ENABLED WHEN THE CURRENT VALUE OF THE COUNTER IS NEGATIVE, CURRENT COUNT POSITIVE WHEN DISABLED
27	o———⊣ ⊢———o	CURRENT COUNT LATCH
		ENABLED WHEN EXTERNAL CURRENT COUNT LATCH SWITCH IS ENABLED

OUTPUT REFERENCE	USER LOGIC SYMBOL	OUTPUT FUNCTION DEFINITION

0-17   o——[D●OUT]——●

[CPU ACCUMULATOR] $\rightarrow$ [HSC BUFFER]

WRITES CPU ACCUMULATOR CONTENTS TO HSC BUFFER

23   SET o—(S)——●

[BUFFER] $\rightarrow$ CURRENT COUNT REGISTER

WRITES HSC BUFFER TO THE CURRENT COUNT REGISTER OF HSC*

24   SET o—(S)——●

[BUFFER] $\rightarrow$ PRESET REGISTER

WRITES HSC BUFFER TO THE PRESET REGISTER OF HSC

25   SET o—(S)——●

INITIAL
[PRESET] $> = <$ [CURRENT COUNT]

INITIALLY COMPARES PRESET TO CURRENT COUNT VALUE

30   SET o—●(S) ... RESET (R)

WRITE MODE

ENABLES DATA IN BOX TO BE WRITTEN TO HSC, THE SET AND RESET INSTRUCTIONS INITIATE AND TERMINATE THIS TRANSFER OF DATA
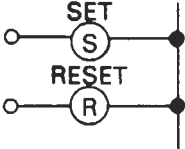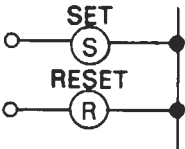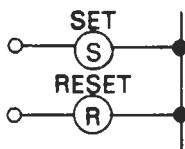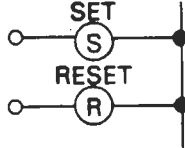
* CAN ALSO BE DONE WITH EXTERNAL CURRENT COUNT LOAD INPUT

** DATA SENT TO HSC

OUTPUT REFERENCE	USER LOGIC SYMBOL	OUTPUT FUNCTION DEFINITION

31

CURRENT COUNT/PRESET SIGN

IF REFERENCE NO. 31 IS SET WHEN A VALUE IS SENT FROM THE CPU ACCUMULATOR TO THE HSC BUFFER, THE VALUE IS CONSIDERED NEGATIVE.

32

OUTPUT NO. 1 STATE

IN MANUAL MODE CONTROLS THE STATUS OF OUTPUT NO. 1 AS A NORMAL DISCRETE OUTPUT

IN COUNTER MODE ENABLES HSC OUTPUT NO. 1 ASSUMING THE APPROPRIATE RELA-TIONSHIP BETWEEN THE PRESET AND CUR-RENT COUNT (SEE FIGURES 12, 13, and 14)

33

OUTPUT NO. 1 MODE SELECT

ENABLED: MANUAL MODE

DISABLED: COUNTER MODE

OUTPUT REFERENCE	USER LOGIC SYMBOL	OUTPUT FUNCTION DEFINITION

34

SET
(S)
RESET
(R)

OUTPUT NO. 2 STATE

IN MANUAL MODE CONTROLS THE STATUS OF OUTPUT NO. 2 AS A NORMAL DISCRETE OUTPUT.

IN COUNTER MODE ENABLES HSC OUTPUT NO. 2 ASSUMING THE APPROPRIATE RELA-TIONSHIP BETWEEN THE PRESET AND CUR-RENT COUNT (SEE FIGURES 12, 13, and 14)

35

SET
(S)
RESET
(R)

OUTPUT NO. 2 MODE SELECT

ENABLED: MANUAL MODE

DISABLED: COUNTER MODE

36

SET
(S)
RESET
(R)

OUTPUT NO. 3 STATE

IN MANUAL MODE CONTROLS THE STATUS OF OUTPUT NO. 3 AS A NORMAL DISCRETE OUTPUT.

IN COUNTER MODE ENABLES OUTPUT NO. 3 ASSUMING THE APPROPRIATE RELATION-SHIP BETWEEN THE PRESET AND CURRENT COUNT (SEE FIGURES 12, 13, and 14)

37

SET
(S)
RESET
(R)

OUTPUT NO. 3 MODE SELECT

ENABLED: MANUAL MODE

DISABLED: COUNTER MODE

D.   OUTPUT LOGIC

Each of the three HSC outputs operate in either the manual or counter mode. The operating mode of each output is determined by the state of its mode select function (Refer to Interface to User Logic Section).

If Mode Select Disabled (0):   Counter Mode
If Mode Select Enabled (1):   Manual Mode

The logic of each mode will be covered separately.

MANUAL MODE

The state of an output in the manual mode corresponds to the status of its associated Output State Function (Refer to Figure 11).

OUTPUT MODE SELECT	OUTPUT STATE	OUTPUT
1	0	0
1	1	1

Figure 11
OUTPUT LOGIC IN MANUAL MODE

COUNTER MODE

In the counter mode of operation, an output can react immediately when the current count reaches specific preset values. In this mode each output is controlled by a combination of two factors.

1. Status of Output State Function

2. Relationship between the current count and the preset value*

*NOTE: Upon power up or the transition from program to run mode the HSC assumes a preset of zero

—

COUNTER MODE (Continued)

To have an output enabled in the counter mode of operation two conditions must be met:

1. Associated output state function enabled

2. Proper relationship between the current count and preset value

If the preset is positive (+0001 to +9999), the output is enabled when the current count is less than the preset value (Refer to Figure 12).

Figure 12
OUTPUT LOGIC FOR POSITIVE PRESET

If the preset is zero (0000), the output is enabled when the current count is negative (Refer to Figure 13). Note that zero is the default preset.
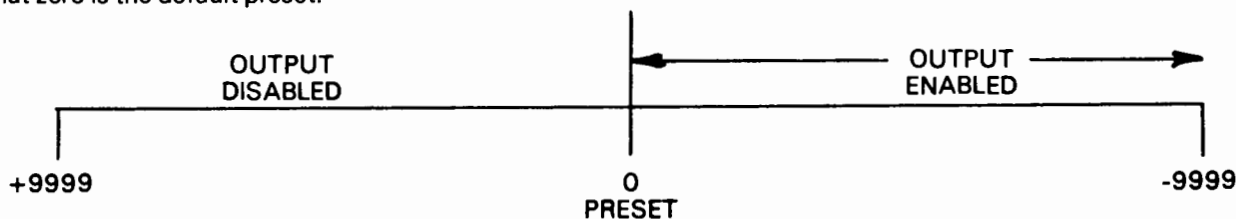
Figure 13
OUTPUT LOGIC FOR PRESET OF ZERO

If the preset is negative, (-0001 to -9999) the output is enabled if the current count is greater than the preset value (Refer to Figure 14).
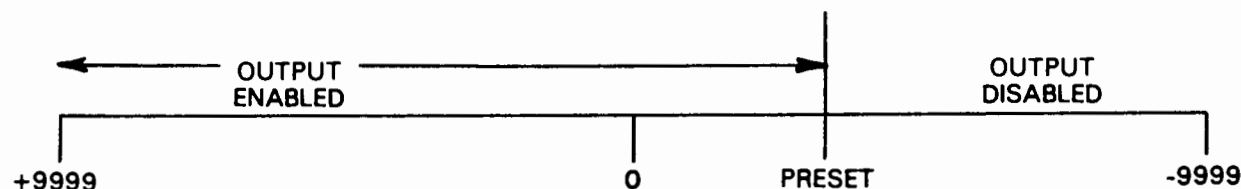
Figure 14
OUTPUT LOGIC FOR NEGATIVE PRESET

E.   EXAMPLE SYSTEM

To further explain how the Input/Output functions are used to monitor and control the HSC consider the following example system (Refer to Figure 15(. From this system an input function and output function chart are developed in Figure 16 and Figure 17. These charts give numerous examples of how to implement the User Logic/HSC Interface.

SERIES THREE C.P.U.	HIGH SPEED COUNTER 0 ↓ 37	INPUT 40 ↓ 57	OUTPUT 60 ↓ 77	INPUT 100 ↓ 117

Figure 15
EXAMPLE SYSTEM

INPUT FUNCTION   **INSTRUCTION**
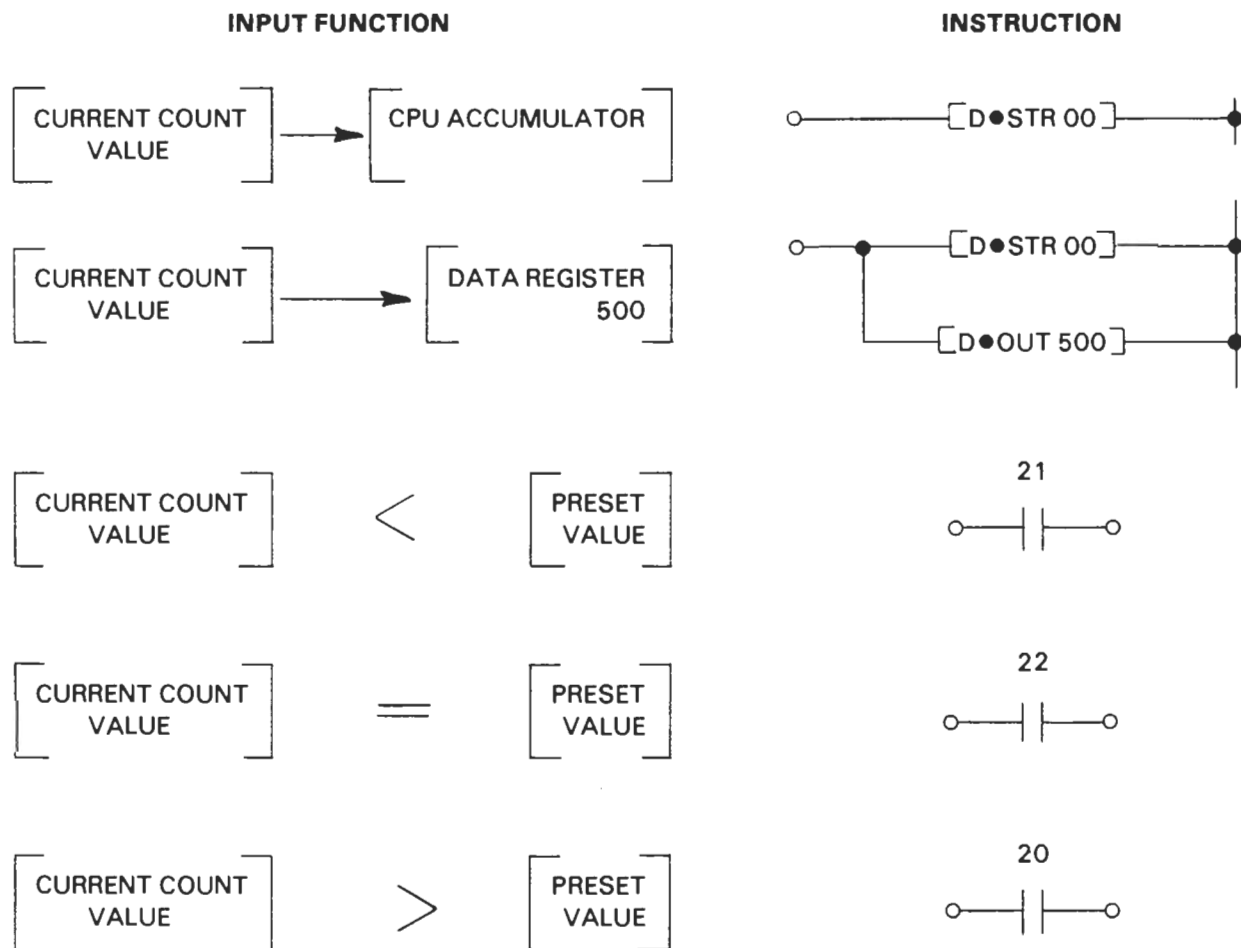
Figure 16
INPUT FUNCTION CHART

OUTPUT FUNCTION

INSTRUCTION
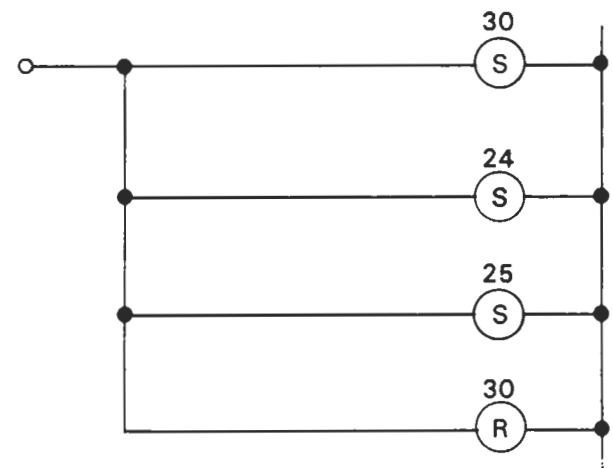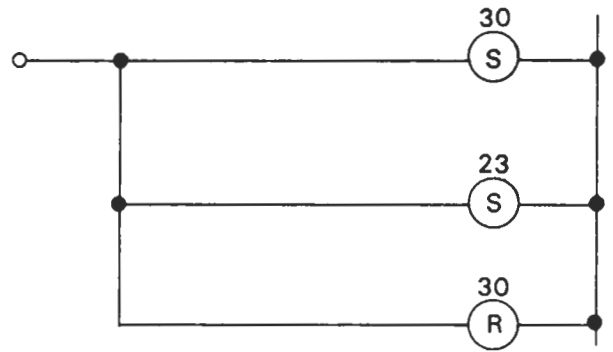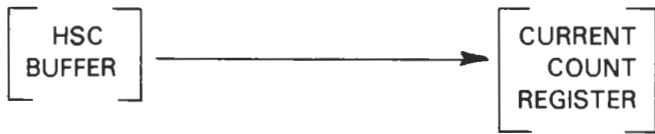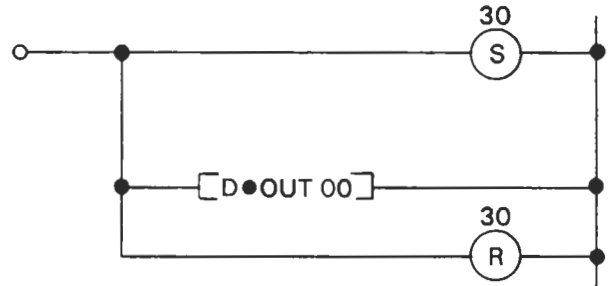
Figure 17
OUTPUT FUNCTION CHART

OUTPUT FUNCTION

INSTRUCTION

DATA REGISTER
500 → HSC
CURRENT
COUNT
REGISTER

30
(S)

[D●STR 500]

[D●OUT 00]

23 .
(S)

30
(R)

DATA REGISTER
500 → HSC
PRESET
REGISTER

30
(S)

[D●STR 500]

[D●OUT 00]

24 .
(S)

25 .
(S)

30
(R)
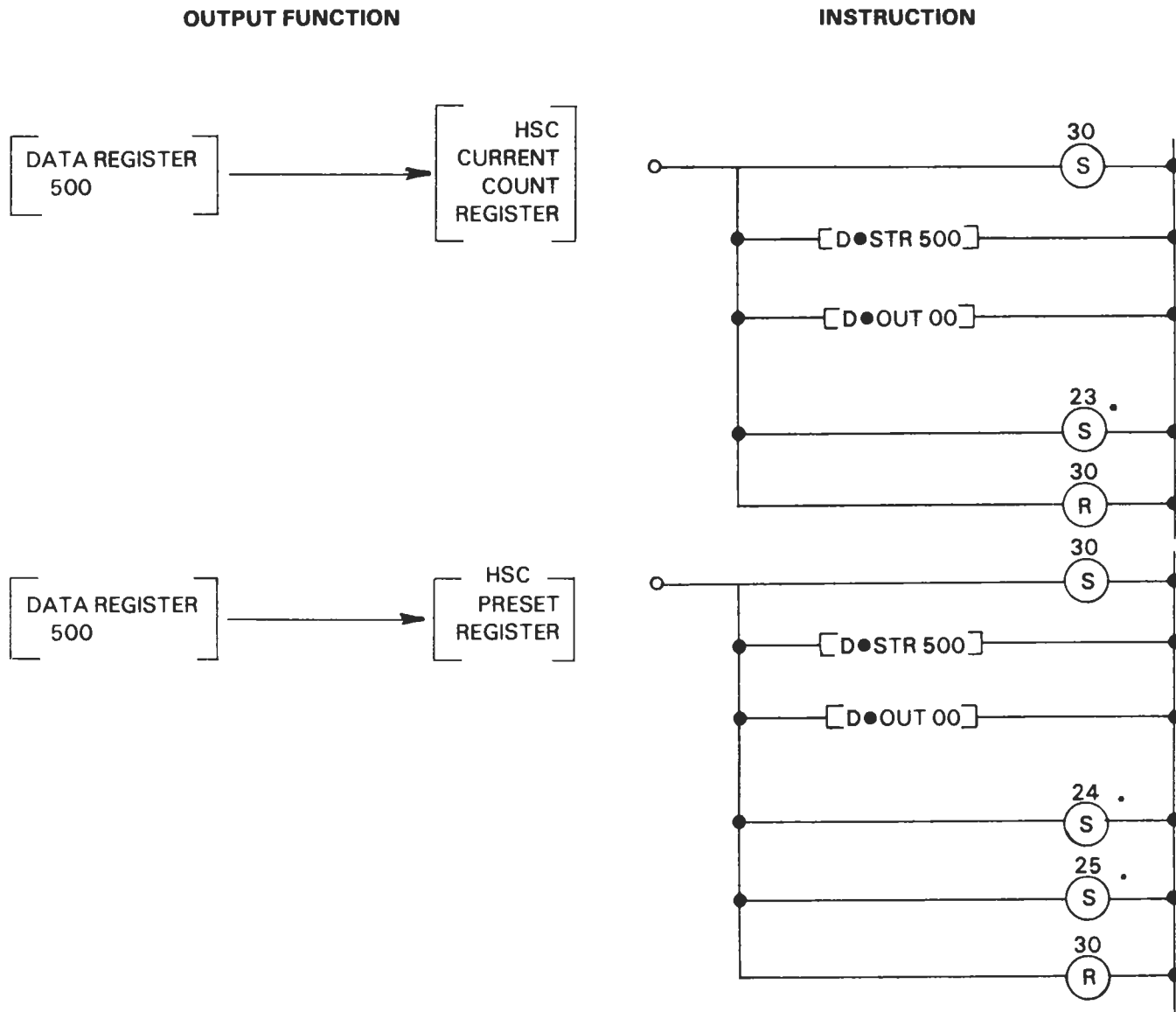
* COILS ARE RESET AUTOMATICALLY AT END OF SCAN

Figure 17 (continued)
OUTPUT FUNCTION CHART

PROGRAMMABLE CONTROL DEPARTMENT, GENERAL ELECTRIC COMPANY, CHARLOTTESVILLE, VIRGINIA

PRODUCT: Series Three

CATEGORY: Product Information

SUBJECT: 24 VAC/DC Source Input Module, IC630MDL311A

AUTHOR: H. A. Konat

4A-003

April 13, 1984

This bulletin describes the 24 VAC/DC Source Input module, which is now available for shipment. This information will be included in a future revision of the Series Three Manual, GEK-25376.

This module provides 16 input circuits, each designed to receive a single discrete (ON/OFF) signal from user supplied devices. These input devices typically include items such as light switches, pushbuttons, selector switches, and relay contacts. The input circuits on the module can interface to either 24 Vac signals or 24 Vdc source-type signals, thereby allowing the module to interface to input devices that provide their own voltage. The ON/OFF condition of each circuit is indicated by an LED located in the logic side of each circuit.

User devices are connected to screw terminals on the faceplate of the module. The 16 circuits are divided into two groups of eight with the commons tied together internally. Each input can have an AC or DC input. Each screw terminal will accept one No. 12 AWG wire or two No. 14 AWG wires. Following are specifications for each of the 16 circuits.

	AC Input	DC Input
Input Voltage	20 to 28 Vac, 50-60 Hz	20-28 Vdc (Source)
Input Current	13 mA (maximum)	13 mA (maximum)
ON Level	20 to 28 Vac	20 to 28 Vdc
OFF Level	0 to 6 Vac	0 to 6 Vdc
OFF to ON Response	5 to 50 msec	5 to 50 msec
ON to OFF Response	5 to 60 msec	5 to 60 msec

Internal Power Consumption   5 Vdc, 90 mA maximum, (supplied by Series Three Power Supply)

USER WIRING   MODULE   TYPICAL REFERENCES

20 - 28 Vac

C   C

0   1   110   111

2   3   112   113

4   5   114   115
A

6   7   116   117

C   C

20-28 Vdc

0   1   120   121

2   3   122   123

NOTE

EACH INPUT CAN   4   5   124   125
HAVE AN AC OR   B
DC POWER SOURCE   6   7   126   127

INTERNAL JUMPER

WIRING DIAGRAM

POLARITY CAN
BE REVERSED

TO NEXT
INPUT CIRCUIT

COMMON

DC   OR   AC

INPUT

OPTICAL
COUPLER

PC-S3-84-0017

SAMPLE INPUT CIRCUIT (1 of 16)
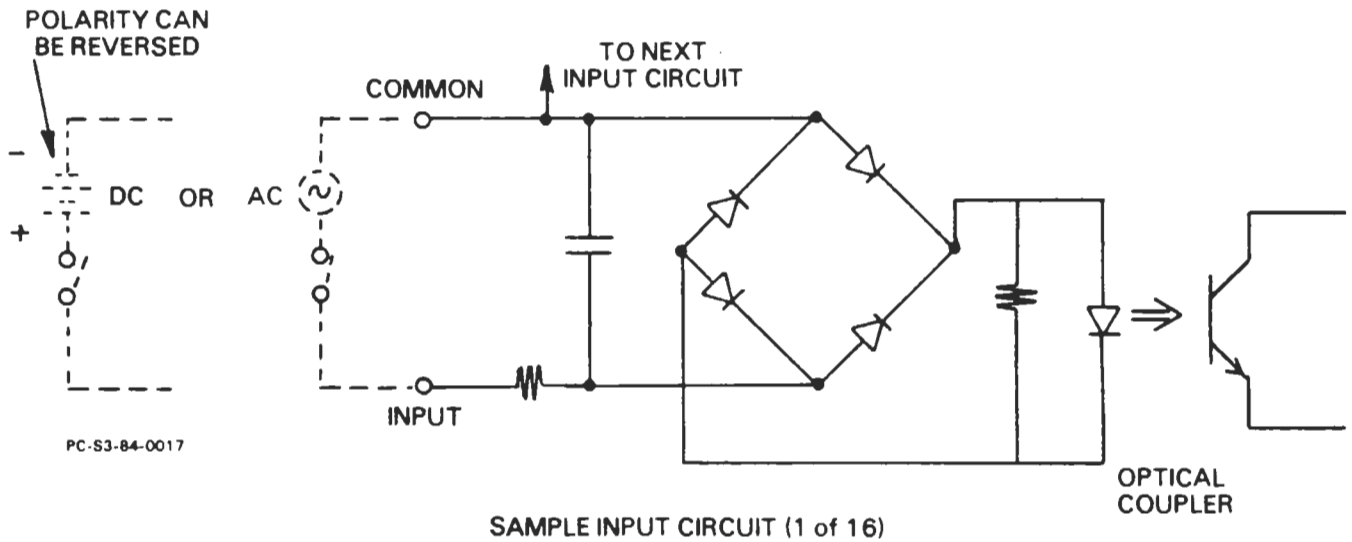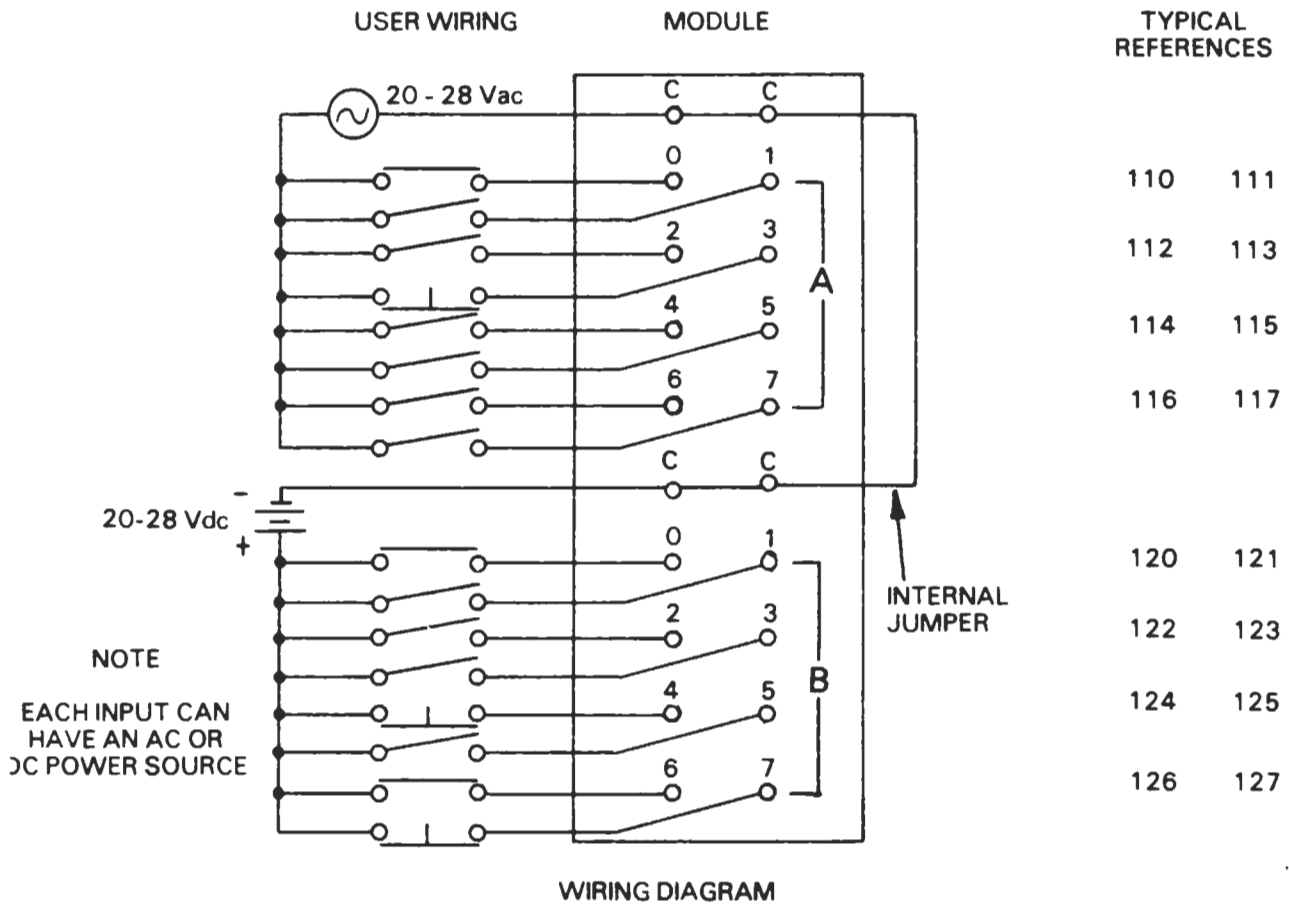
PRODUCT:	Series Three	4A-008
CATEGORY:	Product Information	April 27, 1984
SUBJECT:	Analog Output Module, IC630MDL366A	
AUTHOR:	H. A. Konat	

This bulletin describes the Analog Output module, which is now available for shipment. This information will be included in a future revision of the Series Three Manual, GEK-25376.

The Analog Output module provides two independent output channels, each capable of converting 12 bits of binary data to an analog output. Each channel can provide either 1 to 5V or 4 to 20 mA outputs as required by the application. The module provides 12-bit resolution. Twelve LEDs on the faceplate provide a 12 bit binary display which indicates the resolution as a percent of full scale. A toggle switch on the front panel selects the channel (1 or 2) to be monitored.

The module is capable of driving either single ended or differential voltage devices or current devices. The user devices to be driven are optically isolated from the base power supply by opto-isolators on the module. The opto-isolators provide 1000 Vac of isolation. An Analog Output module requires one I/O slot and consumes 32 consecutive I/O points beginning with the first I/O point of the selected I/O slot.

User field wiring, from devices to be driven is made to a 16-pin connector which mates with a connector mounted on the module's faceplate. One connector is provided with each module. Specifications for this module are provided in the following table.

Table 1
ANALOG OUTPUT SPECIFICATIONS
IC630MDL366A

Output Ranges:	+1 to +5V and 4 to 20 mA, simultaneously
Channels:	2
Resolution:	12 Bit Binary (1 part in 4096)
Field Wiring Termination:	One 16-pin Connector
Visual Display:	12 LEDs (12 bit Binary Display Indicating Output Voltage or Current) Can be used to estimate percent of full scale.
I/O Points Consumed:	32 Consecutive I/O Points (12 modules maximum)
Operating Temperature:	0° to 60^oC
Storage Temperature:	-40° to 100^oC
Humidity:	5% to 95% (non-condensing)
Devices Driven:	Differential or Single Ended Voltage Types or Current Types
External Power Source:	$\pm$ 15V maximum, 100 mA (supplied by user)
Conversion Time:	3 μsec, Maximum
Accuracy:	0.4%
Accuracy vs. Temperature:	50 ppm (parts per million) per 1^oC
Output Impedance:	0.5 Ω, Maximum For Voltage Output
Output Current, Maximum:	15 mA, Voltage Output
Output Resistor Value Maximum:	400 Ω, Current Output
5 Vdc Power Consumption:	330 mA Maximum (supplied by Series Three power supply)

Figure 1 is an illustration of the faceplate for the Analog Output module.

LED DISPLAY

OUTPUT   ANALOG

○ 1
○ 2
○ 4
○ 8
○ 16
○ 32
○ 64
○ 128
○ 256
○ 512
○ 1024
○ 2048

CHANNEL 1 OR CHANNEL 2
SELECTOR SWITCH

CH1 ⊖ CH2

ROW
A

ROW
B

16-PIN CONNECTOR PIN NUMBERING
AS VIEWED AT FRONT OF FACEPLATE
MATING CONNECTOR TO USER DEVICES
MUST BE WIRED. CONNECTOR PROVIDED
WITH MODULE.

PIN 1

PC-S3-84-0018
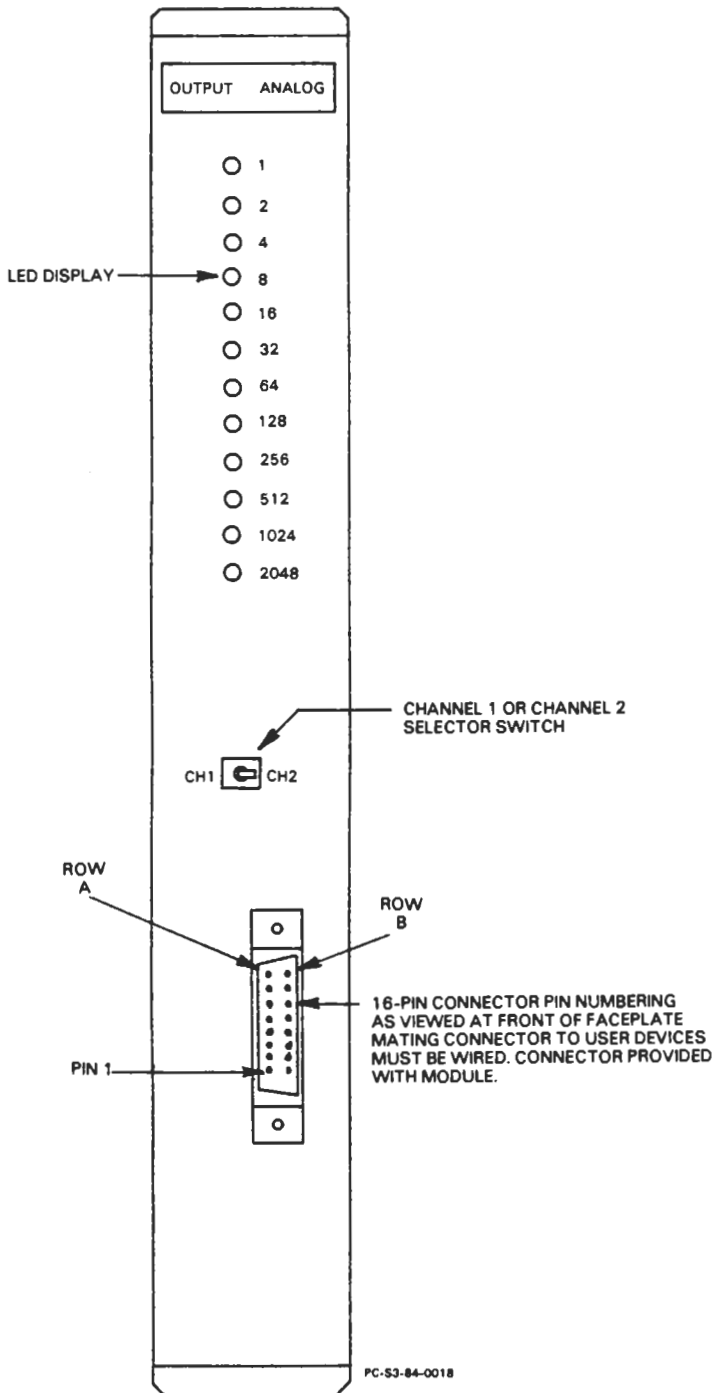
The Analog Output module is capable of driving devices requiring either differential or single ended input voltage or current inputs. The following group of illustrations are typical electrical connections for each type of device. For each figure a block diagram of the module is illustrated and the connections required for interfacing the Analog outputs to each type of device.

NOTES

1. **Maximum loading is ± 15 mA for full voltage output (does not apply to 4 to 20 mA output).**

2. **Both outputs on this module are single ended and are referenced internally to the same user side common which is isolated from the Series Three ground.**

3. **All OV (user side common) points are connected together internally in this module.**

4. **If multiple destinations are connected to the same output module, their reference points (OV) must be connected together and be at the same voltage.**

5. **Twisted-pair cable should be used when possible, twisted pair with shield is preferred.**

Figure 1
ANALOG OUTPUT MODULE FACEPLATE
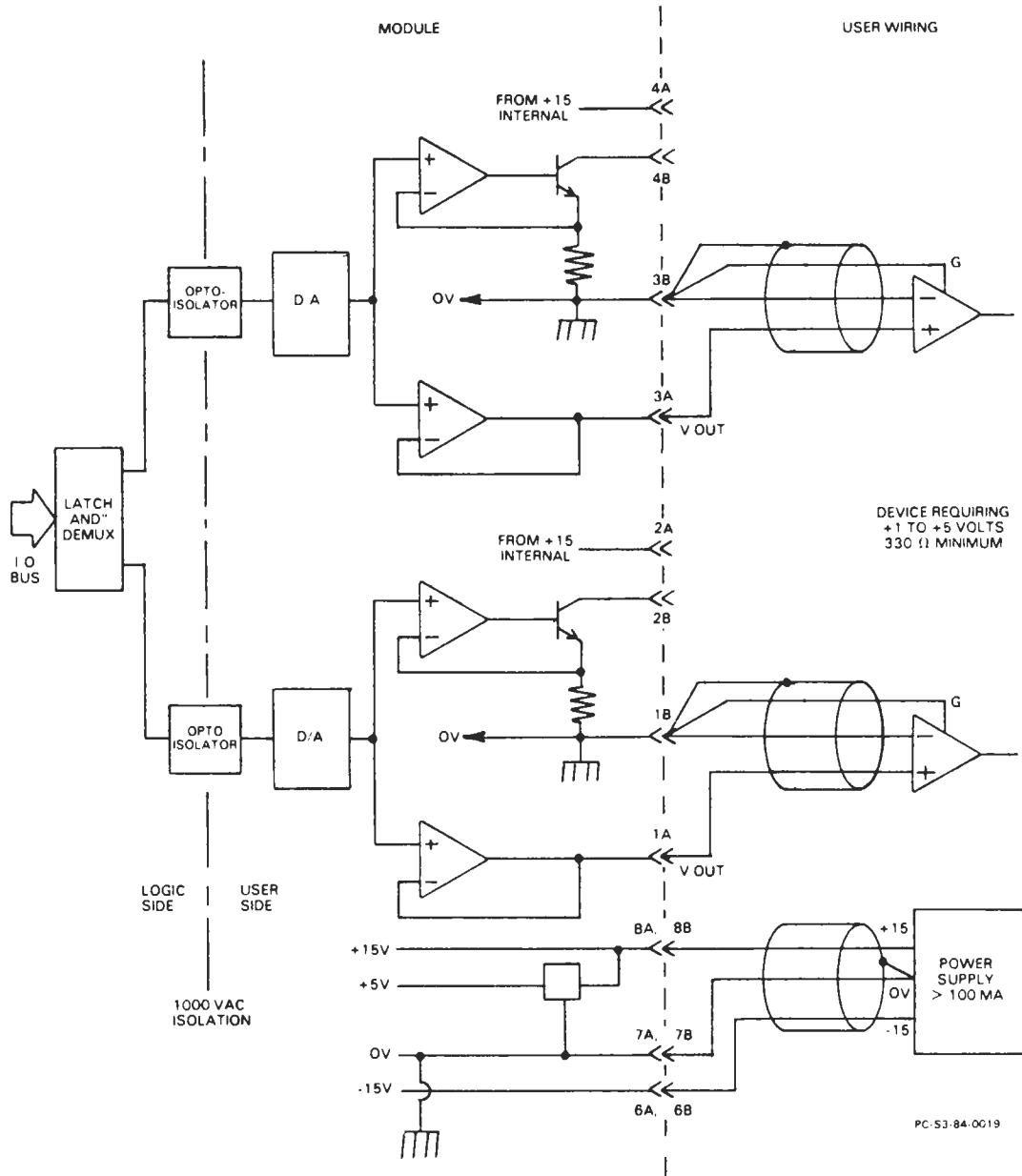
Figure 2
OUTPUTS DRIVING DIFFERENTIAL VOLTAGE INPUT
DEVICE, TYPICAL CONNECTIONS
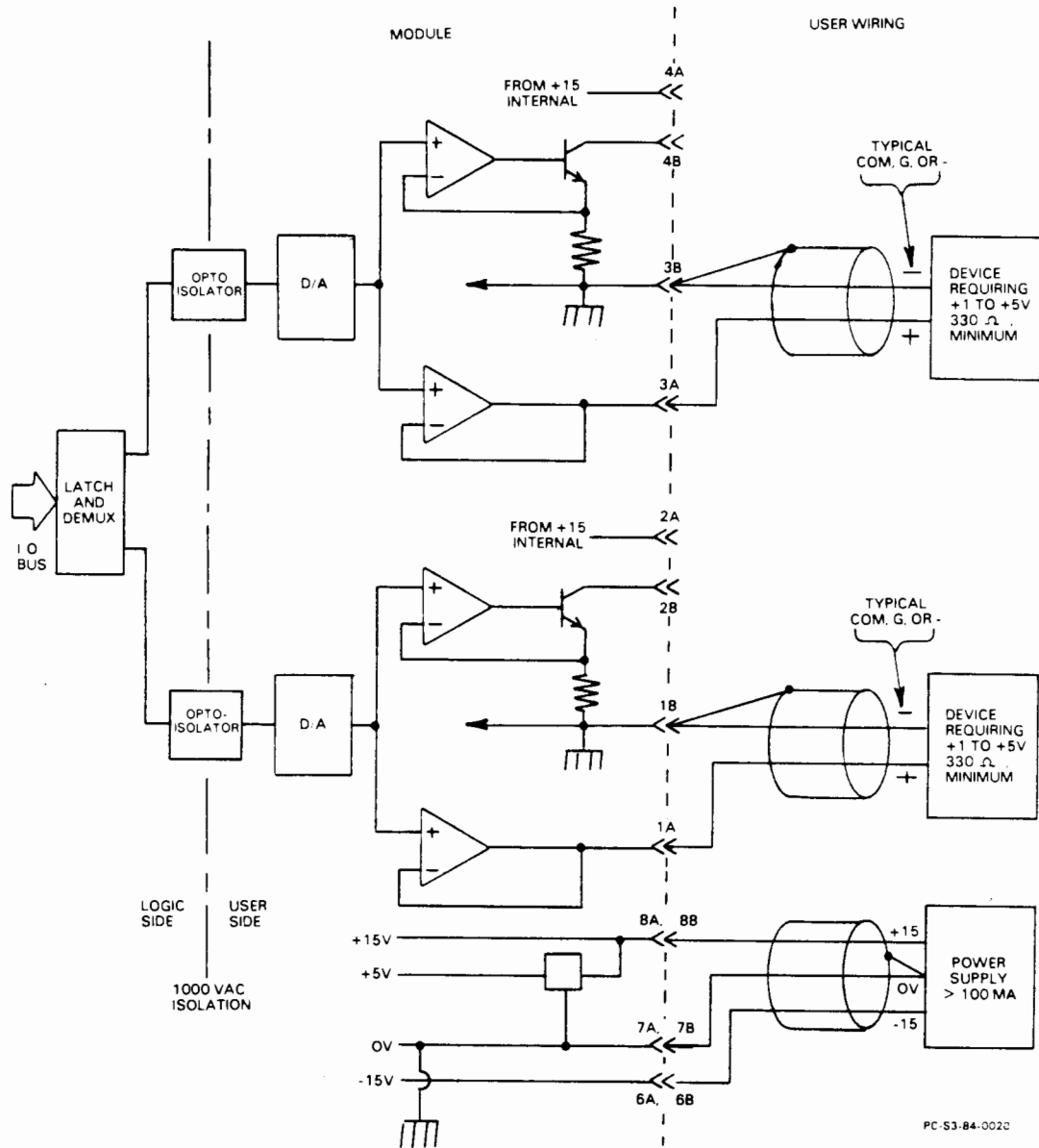
Figure 3
OUTPUTS DRIVING SINGLE ENDED VOLTAGE
INPUT DEVICE, TYPICAL CONNECTIONS

MODULE   USER WIRING

250 Ω TYPICAL
400 Ω MAXIMUM

FROM +15
INTERNAL

4A

4B

3B

3A

250 Ω TYPICAL
400 Ω MAXIMUM

FROM +15
INTERNAL

2A

2B

1B

1A

LATCH
AND
DEMUX

I O
BUS

OPTO
ISOLATOR

D/A

OPTO
ISOLATOR

D A

LOGIC   USER
SIDE   SIDE

1000 VAC
ISOLATION

+15V

+5V

OV

-15V

8A   8B

7A   7B

6A   6B

POWER
SUPPLY
> 100 MA

+15

OV

-15

OV

OV

PC-53-84-0021

Figure 4
OUTPUTS DRIVING 4 TO 20 MA DEVICES WITH INTERNAL SUPPLY
FOR LOOP CURRENTS, TYPICAL CONNECTIONS

DATA FORMAT

An Analog Output module uses 32 consecutive I/O points beginning with the first I/O point for the I/O slot select-
ed for the module. Each of the 2 channels uses 12 of the 32 points for data. The following table shows the data
format for each channel relative to I/O points.

I/O POINT		CHANNEL	BIT	I/O POINT		CHANNEL	BIT
n	0	1	0	n+2	0	2	0
	1		1		1		1
	2		2		2		2
	3		3		3		3
	4		4		4		4
	5		5		5		5
	6		6		6		6
	7		7		7		7
n+1	0		8	n+3	0		8
	1		9		1		9
	2		10		2		10
	3		11		3		11
	4		Not Used		4		Not Used
	5		Not Used		5		Not Used
	6		Not Used		6		Not Used
	7	CH 1	D/A Start		7	CH 2	D/A Start

n = I/O Point XX0 (e.g. 0040 to 0077)

PROGRAMMING

The Series Three must be programmed to transfer a 12-bit binary value to the CPU's accumulator, and then
transfer the accumulator content to Channel 1 or Channel 2 for conversion to an analog level. This is done by
moving the binary value in the accumulator to the D/A module's selected channel by using a D●OUT instruction.
The D/A conversion is initiated by setting bit 16 of the data format for a channel in the D/A module. Examples of
the required programming instructions are shown below. Assume that the D/A module is inserted in an I/O slot
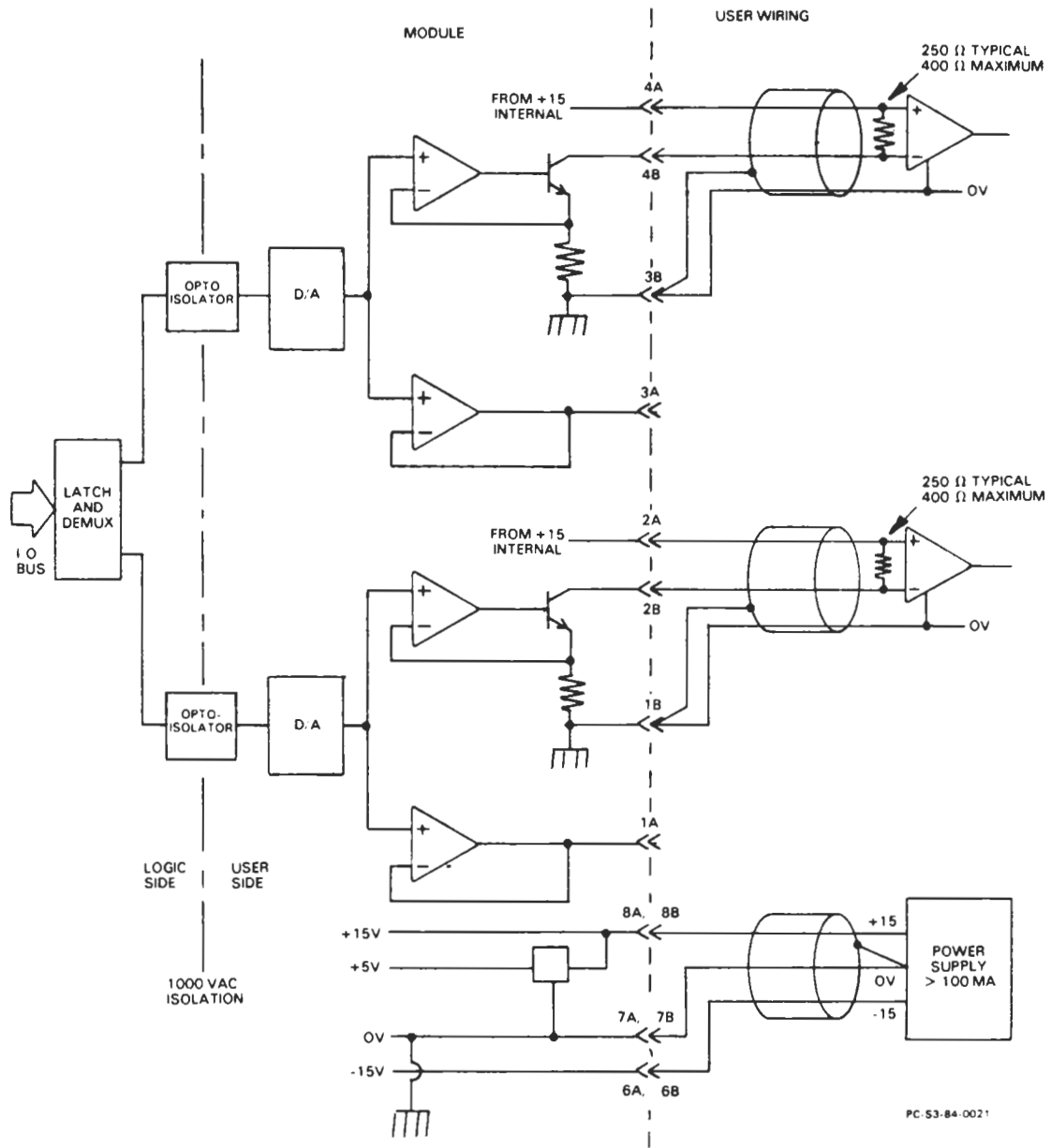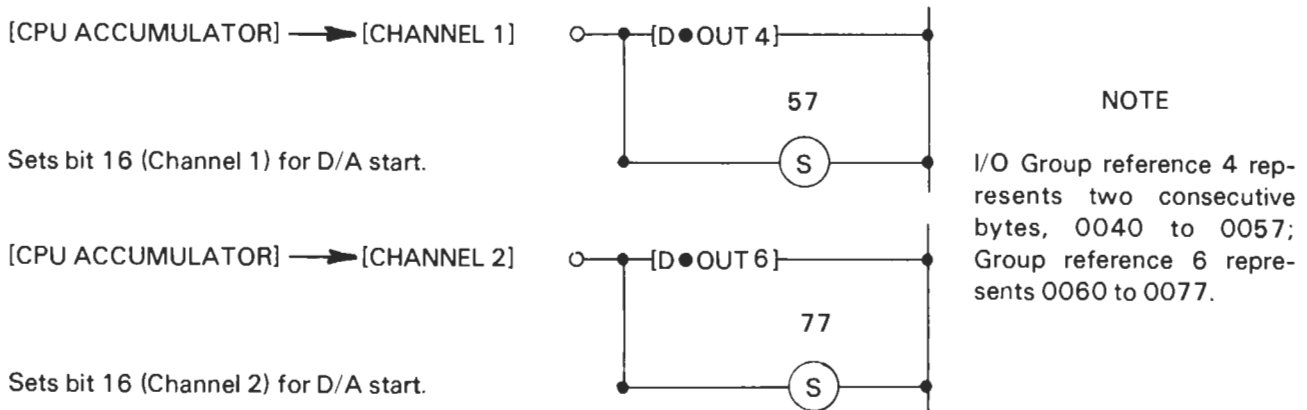that uses I/O points 0040 to 0077.

[CPU ACCUMULATOR] ➤ [CHANNEL 1]   o—●—[D●OUT 4]————————●

                                              57   NOTE

Sets bit 16 (Channel 1) for D/A start.   ●————————(S)————————●   I/O Group reference 4 rep-
                                                                  resents two consecutive
                                                                  bytes, 0040 to 0057;
[CPU ACCUMULATOR] ➤ [CHANNEL 2]   o—●—[D●OUT 6]————————●   Group reference 6 repre-
                                                                  sents 0060 to 0077.

                                              77

Sets bit 16 (Channel 2) for D/A start.   ●————————(S)————————●

**SERIES
ONE/THREE/SIX
BULLETIN**

GENERAL ⑥ ELECTRIC

**PROGRAMMABLE
CONTROL
DEPARTMENT**

PRODUCT:	Series Three	4A-009
CATEGORY:	Product Information	April 27, 1984
SUBJECT:	Analog Input Module, IC630MDL316A	
AUTHOR:	H. A. Konat	

This bulletin describes the Analog Input module, which is now available for shipment. This information will be included in a future revision of the Series Three Manual, GEK-25376.

The Analog Input module provides two independent input channels capable of converting an analog input signal to a digital signal. The user can select, by jumper placement, to use either voltage or current inputs as required by the application. Resolution is 12 bits and the 12-bit binary LED display provides a visual indication of the input. A toggle switch selects the channel to be monitored by the LED display (Channel 1 or 2).

This module can interface to either single ended or differential voltage sources or to a current source. The analog-to-digital (A/D) converter on this module is an integrating type converter. The integrating converter provides immunity to noise spikes and has excellent 60 Hertz noise rejection. Opto-isolators on the module provide 1000 Vac of isolation between the user inputs and the base power supply. An Analog Input module consumes 32 consecutive I/O points, beginning with the first I/O point of the selected I/O slot.
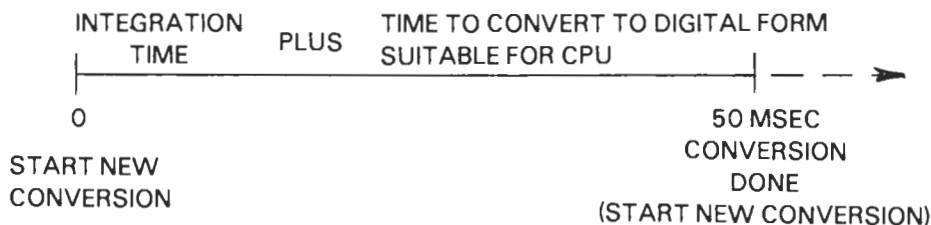
User field wiring is made to a 16-pin connector which mates with a connector mounted on the faceplate. One connector is provided with each module. Specifications for this module are provided in the following table.

Table 1
ANALOG INPUT SPECIFICATIONS
IC630MDL316A

Input Ranges:	+1 to +5V, +1 to +10V, 0 to +10V or 4 to 20 ma (jumper selectable)
Channels:	2
Resolution:	12 Bit Binary (1 part in 4096)
Field Wiring Termination:	One 16-pin Connector
Visual Display:	12 LEDs (12 bit Binary Display Indicating Input Voltage or Current) Can be used to estimate percent of full scale
I/O Points Required:	32 Consecutive I/O Points (12 modules maximum)
Operating Temperature:	0° to 60°C
Storage Temperature:	-40° to 100°C
Humidity:	5% to 95% (non-condensing)
Input Types:	Differential, Single Ended or Current (Jumper Selectable)
Impedance:	1 M Ω Minimum (Voltage) 250 Ω Typical (Current)
External Power Source:	± 15V, 150 mA (supplied by user)
Absolute Maximum Ratings:	Input Voltage, ± 15V
Conversion Time:	50 msec (minimum time between samples)
Sample Time:	50 msec plus one scan (typical)
Accuracy:	± .4% at 25°C
Linearity:	± .01%
Accuracy vs. Temperature:	± 100 ppm (parts per million) per 1°C
5 Vdc Power Consumption:	300 mA Maximum (supplied by Series Three power supply)

Explanation of Conversion Time and Sample Time

Conversion Time:	The time required to look at the input signal, convert it to a digital value and otherwise prepare it for use by the CPU. For the IC630MDL316A, this time is 50 ms.

```
INTEGRATION              TIME TO CONVERT TO DIGITAL FORM
    TIME      PLUS       SUITABLE FOR CPU
|----------------------------------------------|  — — ➤
0                                          50 MSEC
                                          CONVERSION
START NEW                                    DONE
CONVERSION                          (START NEW CONVERSION)
```

Sample Time:

The time between successive readings of the analog input that will result in new data being used by the CPU. For the IC630MDL316A, this time is typically one conversion time plus CPU scan time (one conversion time plus two scan times worse case). This is the key timing parameter that must be considered in system designs using this module.

Assume typical CPU scan time is 20 msec (represents typical scan time for a system with 2K memory and 256 I/O).

END CONVERSION NO. 1
START CONVERSION NO. 2

END CONVERSION NO. 2
START CONVERSION NO. 3

─────── 50 MS ───────

ANALOG CONVERSION

CPU SCANS

20 MS　　20 MS　　20 MS　　20 MS

CONVERSION NO. 1
DATA READ BY
CPU FIRST TIME

CONVERSION NO. 1
DATA READ
BY CPU AGAIN

CONVERSION NO. 2
DATA READ BY
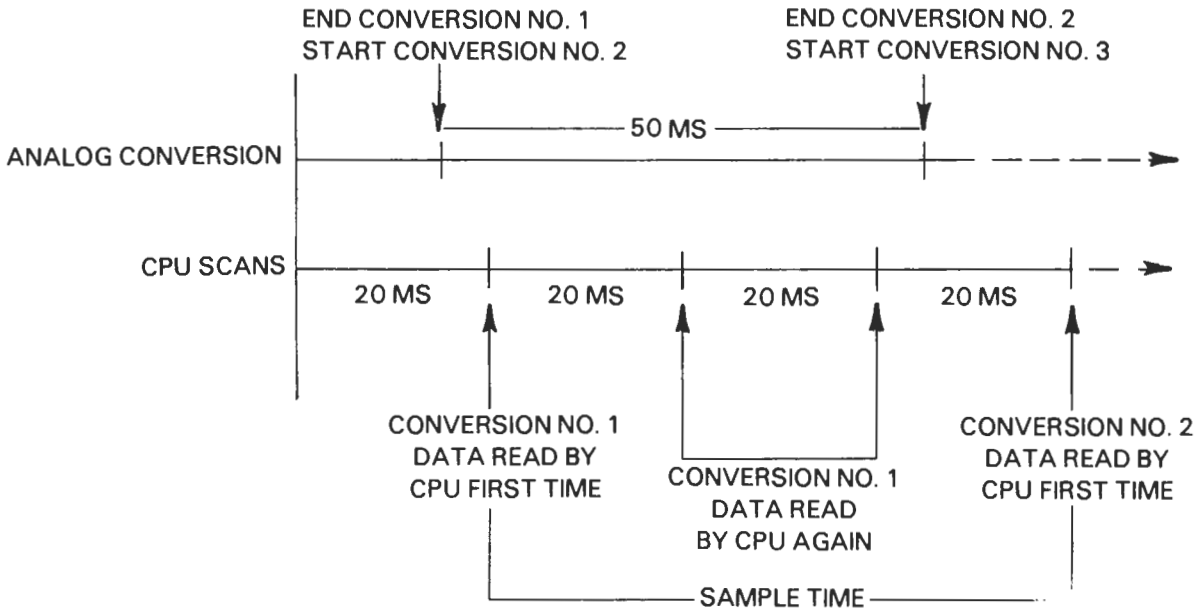CPU FIRST TIME

──────── SAMPLE TIME ────────

Figure 1 is an illustration of the faceplate for the Analog Input module.
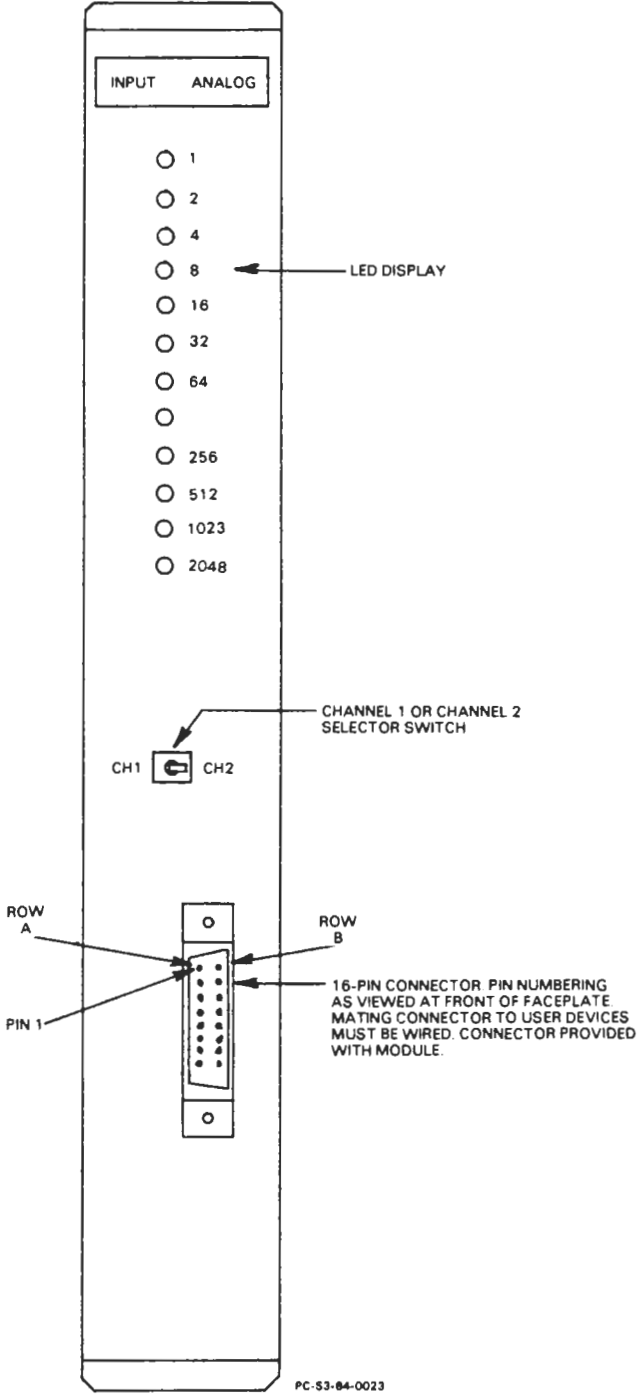

Figure 1
ANALOG INPUT MODULE FACEPLATE

Figure 2 is an illustration of the Analog Input module showing jumper locations and definitions. Straps on each of the 4 jumper positions must be configured to correspond to the voltage or current input required for a particular application.
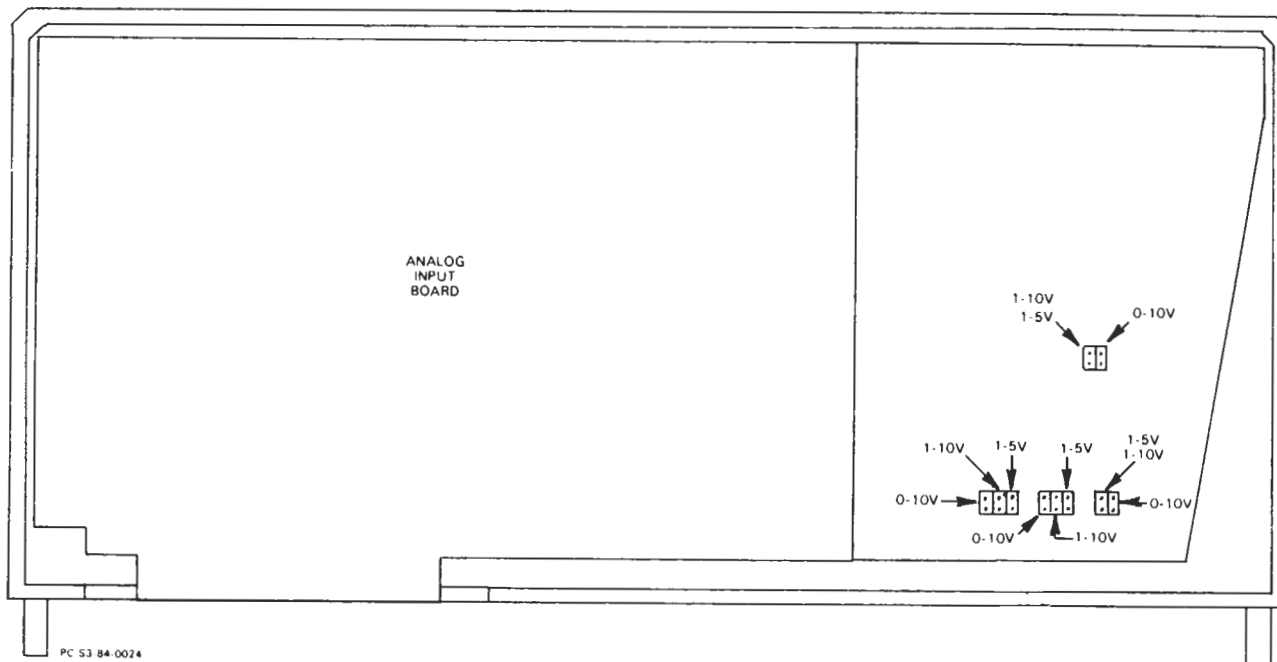

Figure 2
JUMPER LOCATIONS

NOTE

4-20 mA jumper positions are the same as the 1-5V positions.

The Analog Input module can be driven from differential, single ended, or current devices. Electrical connections for each type of device are shown in the following group of figures. For each figure a block diagram of the module is shown and the connections required for interfacing to the various types of inputs.

NOTE

Twisted-pair cable is recommended for user connections whenever possible. Twisted pair with shield is preferred.
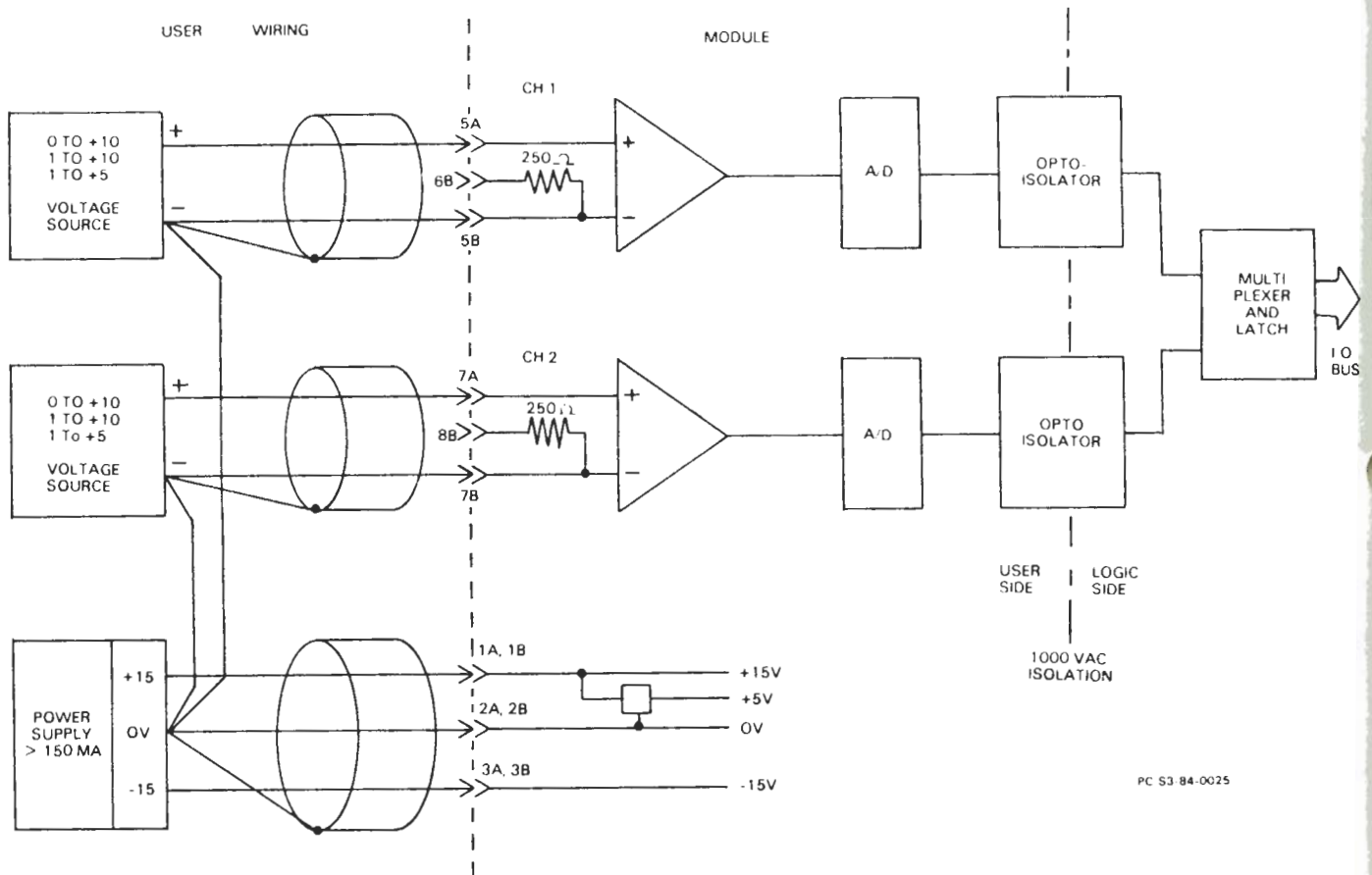
Figure 3
SINGLE ENDED VOLTAGE INPUT, TYPICAL CONNECTIONS

Figure 4
DIFFERENTIAL VOLTAGE INPUT, TYPICAL CONNECTIONS
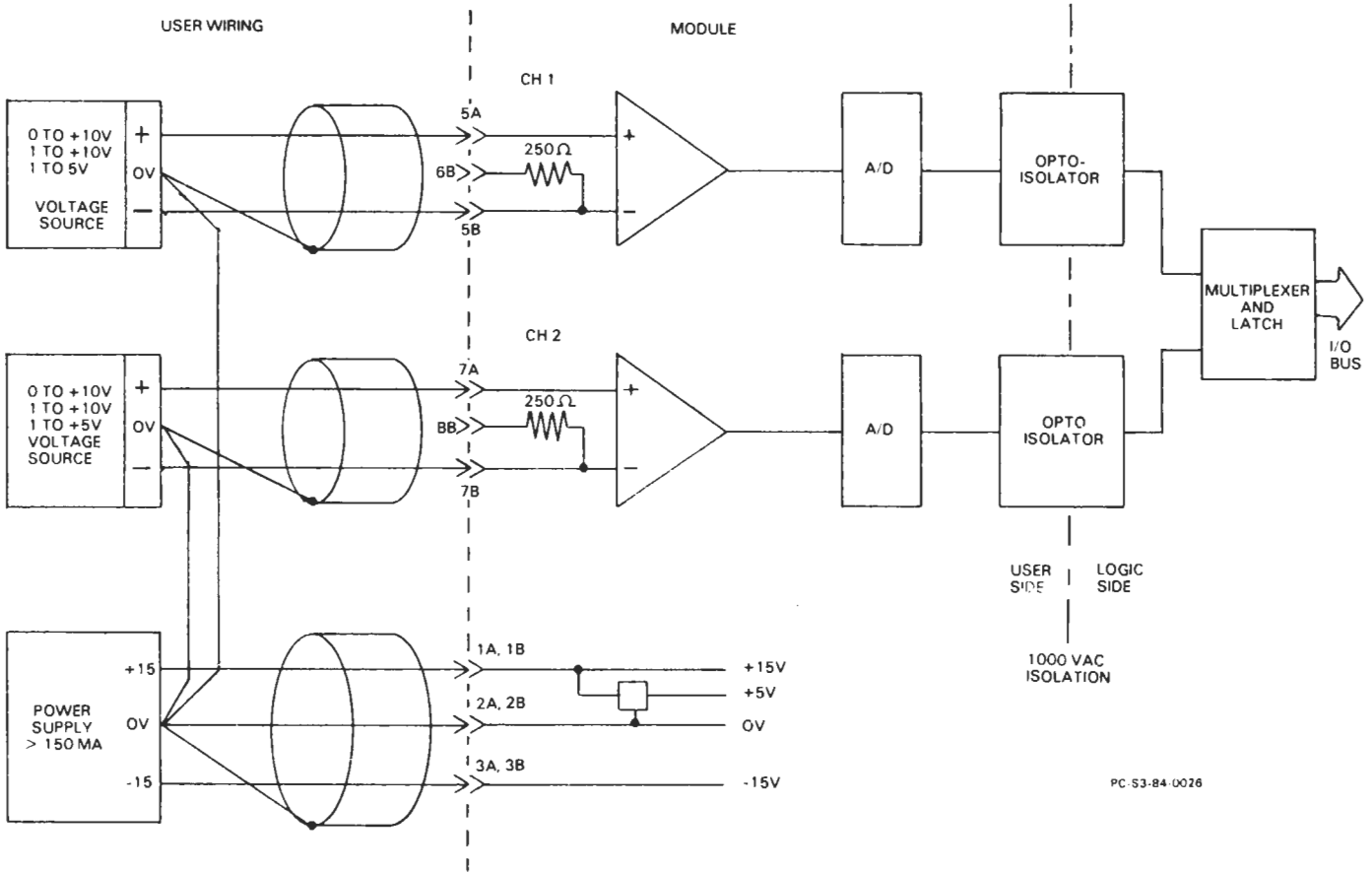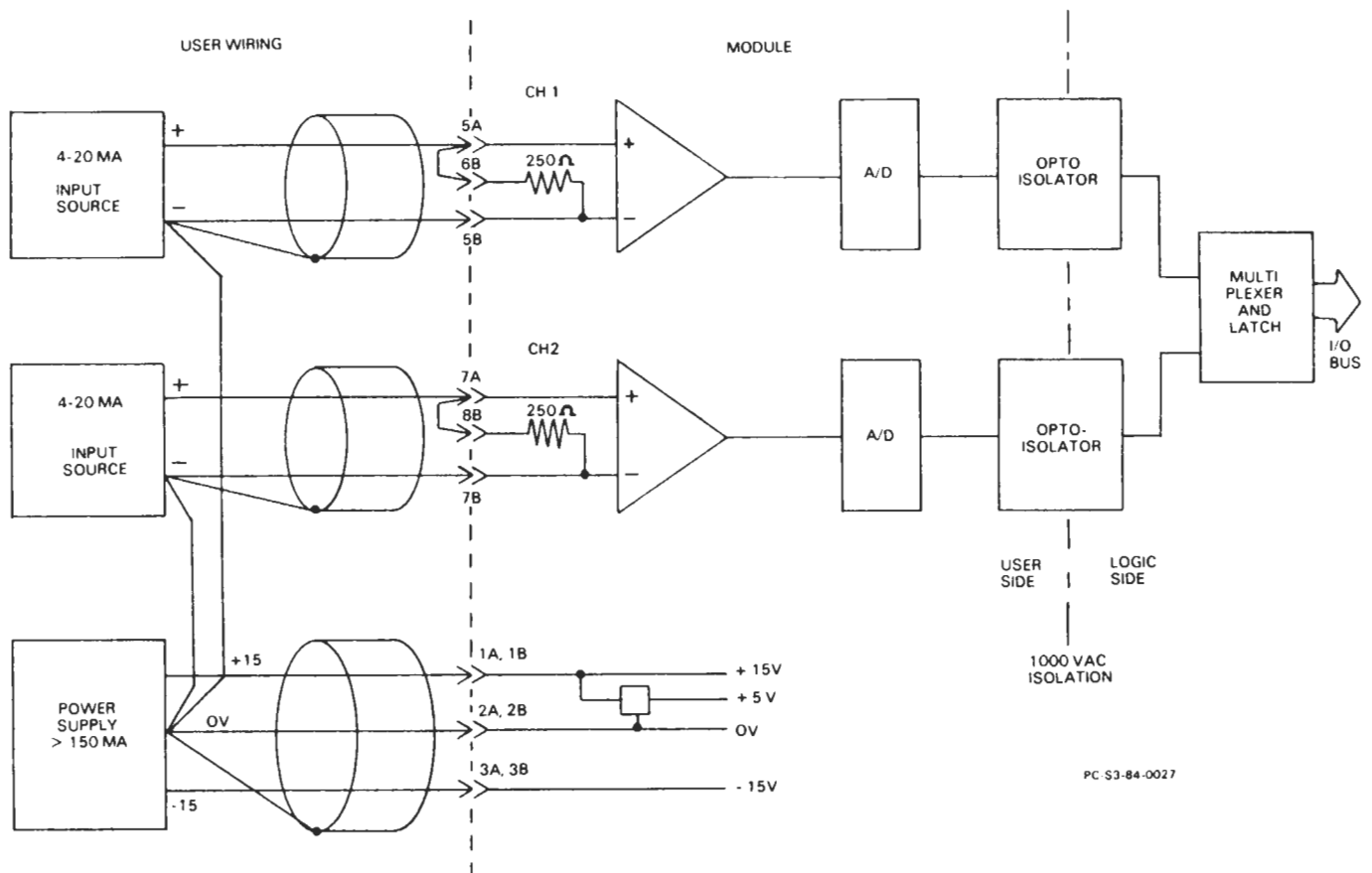
Figure 5
4 TO 20 MA SELF POWERED INPUT SOURCE,
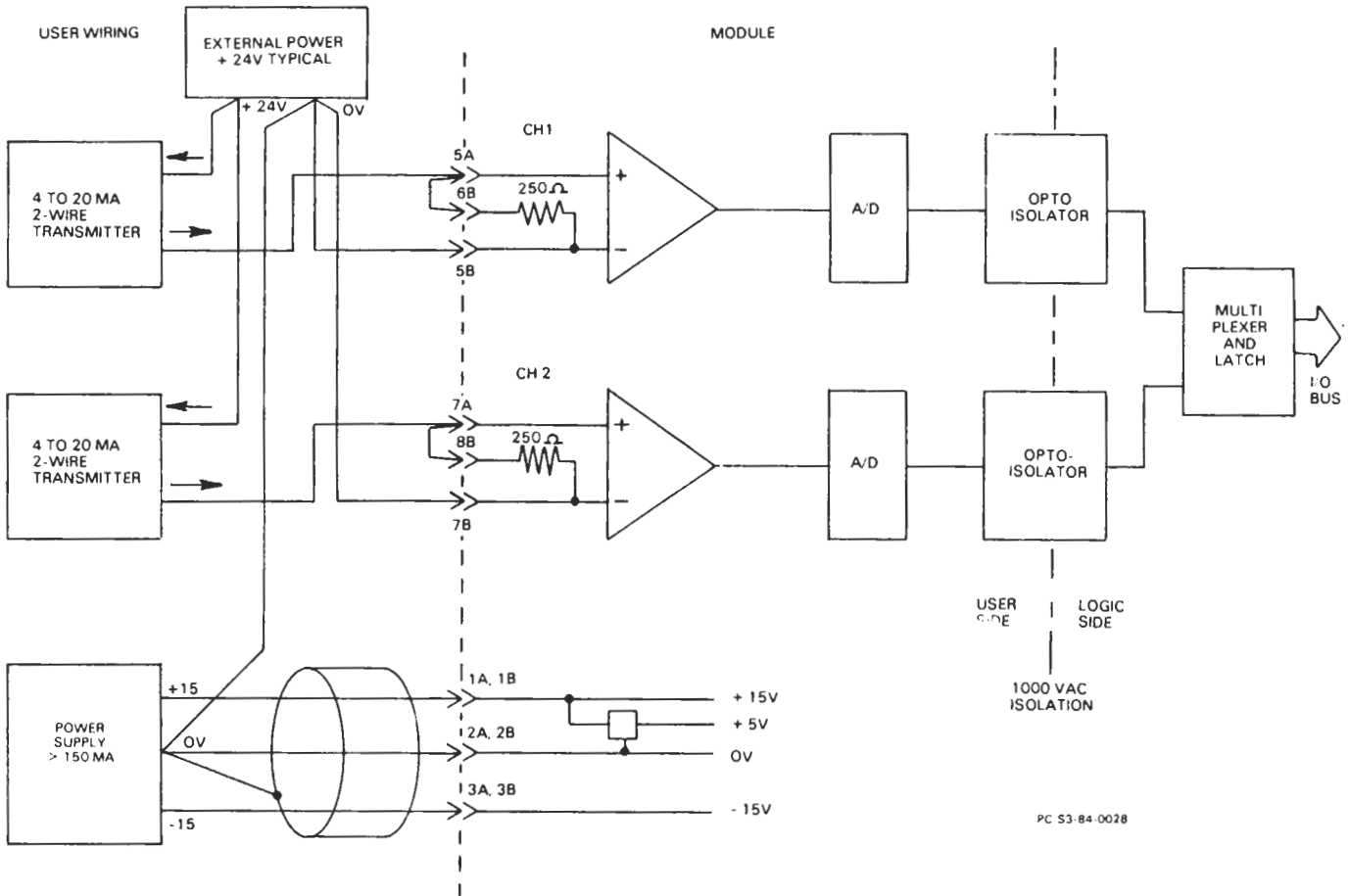**TYPICAL CONNECTIONS**

Figure 6
4 TO 20 MA, WIRE TRANSMITTER (REQUIRING
EXTERNAL POWER), TYPICAL CONNECTIONS

DATA FORMAT

An Analog Input module uses 32 consecutive I/O points beginning with the first I/O point for the I/O slot selected for the module. Each of the 2 channels uses 12 of the 32 points for data. The following table shows the data format for each channel relative to I/O points.

Table 2
ANALOG INPUT DATA FORMAT

I/O POINT		CHANNEL	BIT	I/O POINT		CHANNEL	BIT
n	0	1	0	n+2	0	2	0
	1		1		1		1
	2		2		2		2
	3		3		3		3
	4		4		4		4
	5		5		5		5
	6		6		6		6
	7		7		7		7
n+1	0		8	n+3	0		8
	1		9		1		9
	2		10		2		10
	3		11		3		11
	4		⌠low		4		⌠low
	5	OFF ⟨ low		5	OFF ⟨ low
	6	* � low		6	* � low
	7	⌊low		7	⌊low

n = I/O Point XX0 (e.g. 000 to 037)
* These bits are not used and are always off (logic 0).

PROGRAMMING

The Series Three must be programmed to transfer the Analog Input data to the CPU for processing after it has been converted to a 12-bit binary value. This is done by using the D●STR (Data Store) instruction. When programming the D●STR, the first I/O point of a group of 16 consecutive I/O points must be specified for the Analog Input channel selected. If data is to be read from both channels, then two D●STR instructions are required. After data is loaded into the CPU's accumulator, it must then be processed or loaded into a register or sent to an output. Examples of the required programming instructions are shown below. In this example, assume that the Analog Input module is inserted into the I/O slot next to the CPU and therefore uses I/O points 0000 to 0037.

[CHANNEL 1 DATA] ⟶ [CPU ACCUMULATOR]		○——●—[D●STR 0]——●
[CPU ACCUMULATOR] ⟶ [DATA REGISTER 500]		●—[D●OUT 500]——●
[CHANNEL 2 DATA] ⟶ [CPU ACCUMULATOR]		○——●—[D●STR 2]——●
[CPU ACCUMULATOR] ⟶ [DATA REGISTER 502]		●—[D●OUT 502]——●
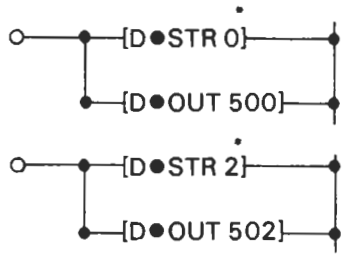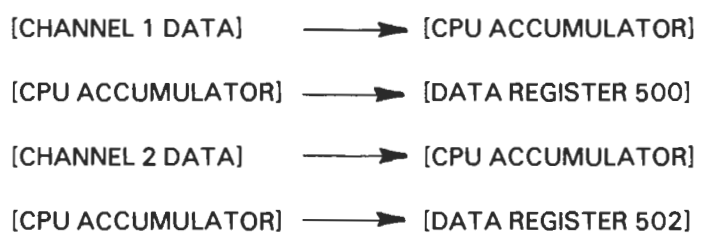
* I/O Group reference 0 represents two unsecutive bytes, 0000 to 0017; Group reference 2 represents 0020 to 0037.

PROGRAMMABLE CONTROL DEPARTMENT, GENERAL ELECTRIC COMPANY, CHARLOTTESVILLE, VIRGINIA

PC

Marketing Information

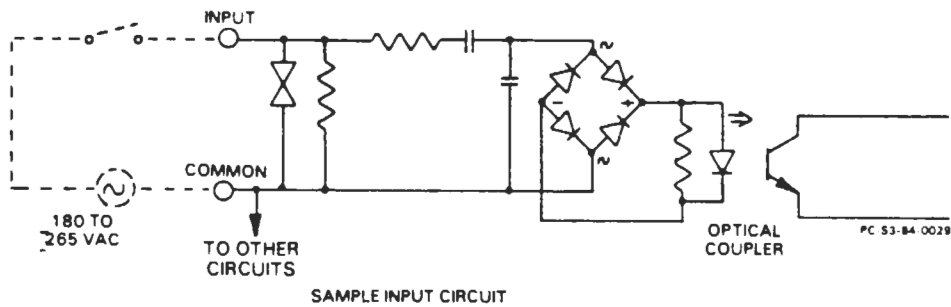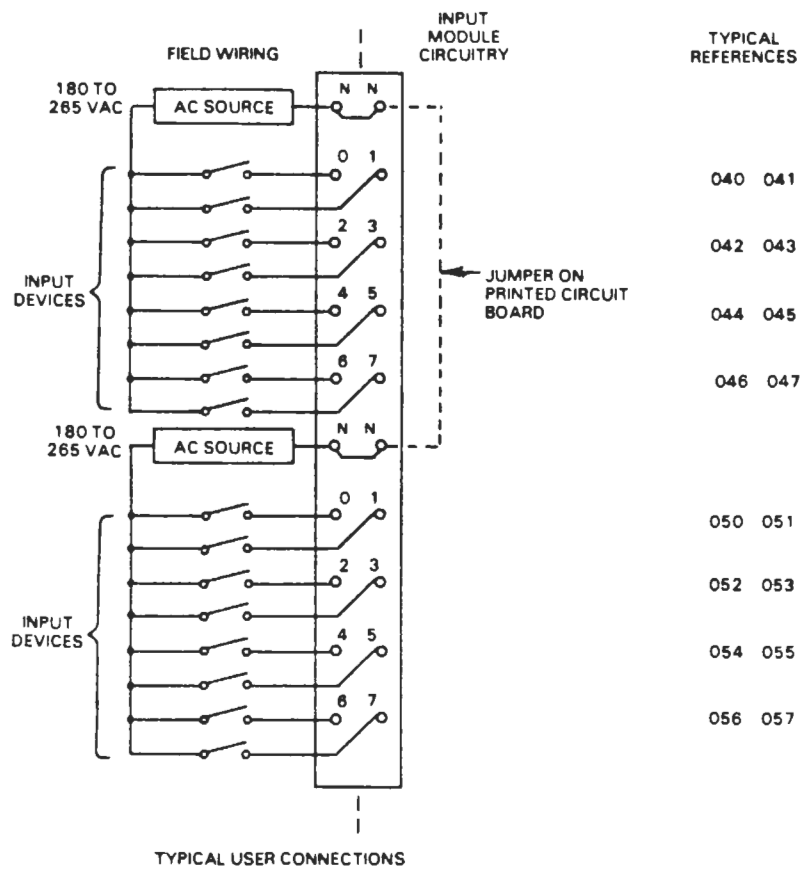|		
PRODUCT:	Series Three Programmable Controller	
CATEGORY:	Product Information	July 31, 1984
SUBJECT:	230 VAC Input Module, IC630MDL327A	
AUTHOR:	H. A. Konat	

This bulletin describes a new product offering, the 230 VAC Input module, now available for shipment. This information will be included in a future revision of the Series Three Manual, GEK-25376.

The 230 VAC Input module has 16 Inputs arranged in two groups with 8 Inputs in each group. An AC voltage source should be connected as shown in the illustration, one side of the voltage source to N, the other side to the input device. The voltage source can be 180 to 265 VAC. The neutral connections are tied together internally. Specifications for this module are listed below.

Input Points	16
Input Voltage	180 to 265 VAC
AC Frequency	48 to 63 Hz
Input current	10.5 mA (180 VAC, 60 Hz), Typical
	15.0 mA (265 VAC, 60 Hz), Typical
	18.0 mA (265 VAC, 60 Hz), Maximum
ON Voltage	Above 180 VAC
OFF Voltage	Below 40 VAC
OFF to ON Response	5-50 msec
ON to OFF Response	5-60 msec
LED Indicators	Logic Side
Internal Power Consumption	5 VDC, 90 mA

Field connections are made to screw terminals on a terminal block mounted on the faceplate. Each terminal will accept up to one No. 12 AWG wire or two No. 14 wire.

GENERAL 🅖🅔 ELECTRIC

INPUT
MODULE
CIRCUITRY

FIELD WIRING

TYPICAL
REFERENCES

180 TO
265 VAC   AC SOURCE   N N

                                    0 1   040   041

                                    2 3   042   043

INPUT   JUMPER ON
DEVICES   4 5   PRINTED CIRCUIT
                                                  BOARD   044   045

                                    6 7   046   047

180 TO
265 VAC   AC SOURCE   N N

                                    0 1   050   051

                                    2 3   052   053

INPUT
DEVICES   4 5   054   055

                                    6 7   056   057

TYPICAL USER CONNECTIONS

INPUT

COMMON

180 TO
265 VAC

TO OTHER
CIRCUITS

OPTICAL
COUPLER

PC S3-84-0029

SAMPLE INPUT CIRCUIT

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