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Overview of the ZAE 201 Counter/ Positioner Module

47

At a Glance

Purpose

The purpose of this chapter is to describe the ZAE 201 Counter/Positioner Module.

What's in this Chapter?

This chapter contains the following sections:

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47.2	Using the ZAE 201 Counter/Positioner Module as a High-Speed Counter	563
47.3	Using the ZAE 201 Counter/Positioner Module as a Positioning Controller	576
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47.1 Overview of the ZAE 201 Counter/Positioner Module

At a Glance

Purpose

This section provides an overview of the ZAE 201 Counter/Positioner Module.

What's in this Section?

This section contains the following topics:

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LED Indicator Displays of the ZAE 201 Counter/Positioner Module	558
Choosing Operating Mode and Input Voltage Level for the ZAE 201 Counter/ Positioner Module	559
Operating States of the ZAE 201 Counter/Positioner Module	560
Representing the ZAE 201 Data Blocks in the I/O Map	561

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What is the ZAE 201 Counter/Positioner Module?

Brief Product Description

The ZAE 201 is a dual-function, user-configurable module that can operate as either a high speed counter or to monitor a simple one–axis positioning application. The ZAE 201 has two output relays, the operation of which are specified when the module is parameterized for either counting or positioning functions. Operational power for the module is 24 Vdc, and position/count signals may be passed to the module as either 5 V (RS422 compatible) or 24 V inputs.

In the counter mode, the unit acts as a high speed counter. Counting is started and stopped by activating and deactivating the count gate input. When counting (count gate activated), two output relays operate based on setup parameters passed to the unit prior to activating the count gate.

In the positioning mode, the unit monitors a single–axis motion. This is accomplished by providing quadrature encoder inputs to the ZAE201. When a motion request is received, the unit will control the state of two output relays based on the current position relative to the commanded position. During motion, the state of two relay outputs are maintained such that speed can be controlled as the target position is approached. The specific operation of these relays is determined by setup parameters passed to the ZAE 201. Direction of motion and absolute speed are determined by other devices controlled through user logic.

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LED Indicator Displays of the ZAE 201 Counter/Positioner Module

LED Indicators

The ZAE 201 has seven LED indicators displayed on the front panel:

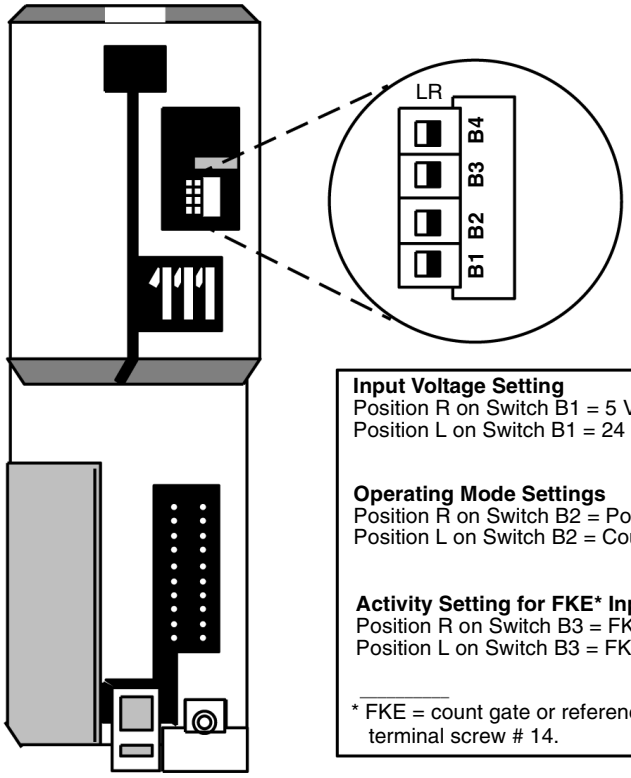
- The green LED opposite terminal screw 1 goes ON to indicate the presence of the 24 V supply voltage
- The amber LED opposite terminal screw 2 may be used as an encoder power monitor if you are using 24 V input signals; if you remove the jumper between terminal screws 1 and 2 and add a wire from the encoder supply, the LED will go ON to indicate a loss of power from the field device. Do not remove the jumper or use this LED with 5 V input signals.
- The green LED opposite terminal screw 12 is the READY LED; its meaning is mode dependent. It goes ON in the positioner mode when the module has been completely parameterized and the reference point trip has been performed. It goes ON in the counter mode when the module has been completely parameterized.
- The amber LED opposite terminal screw 13 is the RUN LED; its meaning is mode dependent. It goes ON in the positioner mode when a motion command is being executed. It goes ON in the counter mode when the module is parameterized and the counter gate is open.
- The red LED opposite terminal screw 14 goes ON to indicate an FKE input active condition.
- The two red LEDs opposite terminal screws 16 and 18 indicate the current condition of relays 1 and 2, respectively. When an LED is ON, its respective relay is closed; when an LED is OFF, its relay is open.

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Choosing Operating Mode and Input Voltage Level for the ZAE 201 Counter/ Positioner Module

Switch Location and Settings

The choices of operating mode and input voltage are set via DIP switches on the back of the module. The module can operate in only one mode and at only one input voltage at a time.



Input Voltage Setting
Position R on Switch B1 = 5 V inputs
Position L on Switch B1 = 24 V inputs

Operating Mode Settings
Position R on Switch B2 = Position sensing mode
Position L on Switch B2 = Counter mode

Activity Setting for FKE* Input
Position R on Switch B3 = FKE* input active LOW
Position L on Switch B3 = FKE* input active HIGH

* FKE = count gate or reference trip input, field wired at terminal screw # 14.

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Operating States of the ZAE 201 Counter/Positioner Module

Operating States

After a ZAE 201 module has been installed, its two output relays must be parameterized for counting or positioning functions. When the Compact-984 Controller is started and begins solving user logic, the ZAE 201 comes up in an initialized but nonfunctional state called NET IN. In order to bring the module into a READY state where it can function, information must be sent to the module identifying how the two relays are to be used and how the FKE input is to be interpreted. The process of sending this information to the module is called **parameterization**, and the specific parameters are dependent upon the module's operating mode.

At the beginning of each scan, the ZAE 201 places the latest status and counter or positioning data in its input data block. The controller uses this information to determine the next command for the module. Commands are stated in the output data block. If no new command is appropriate based on the current information in the input data block, the command byte in the output data block is set to 0.

The ZAE 201's maximum count cannot exceed 8,388,607.

Typically, the command register in the output data block should be cleared at the start of a scan, allowing the user logic to define a new command as required. The command is passed to the module at the end–of–scan. Commands may be given only when the ZAE 201 is not busy, and a command must be consistent with the current state of the module. If either of these conditions is not met, an error will be returned in the input data block.

The ZAE 201 can be reset to a NET IN state at any time. New information can then be passed to the module, thereby redefining the operating parameters before returning to the READY state.

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Representing the ZAE 201 Data Blocks in the I/O Map

Overview

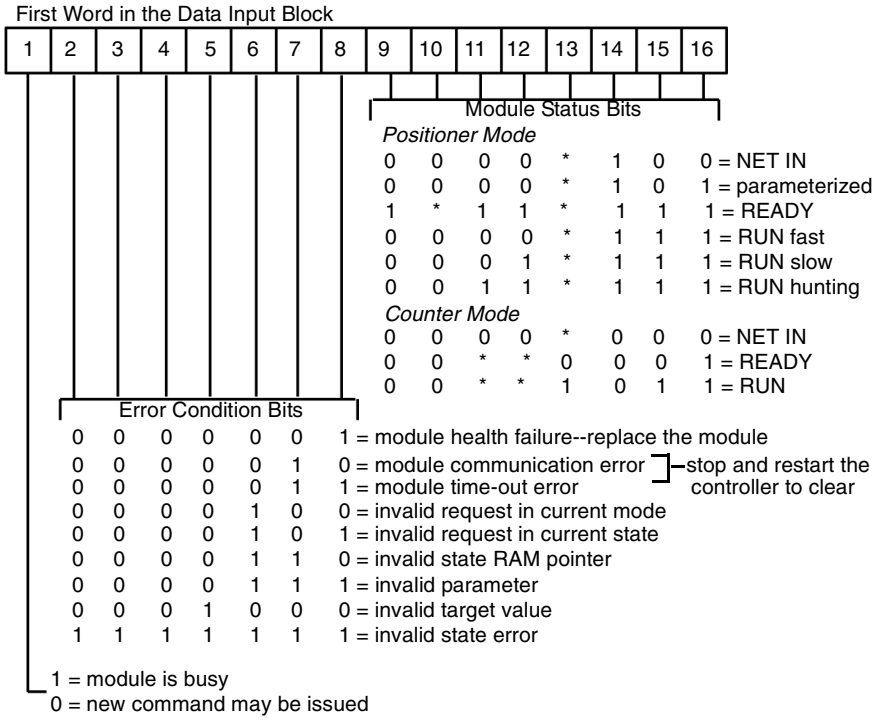
The ZAE 201 is described in the Compact-984 I/O Map as a three-register bidirectional module. Three consecutive 3**x** input registers are used to store the three words in the input data block, and three consecutive 4**x** output registers are used to store the three words in the output data block.

Format of the Input Data Block

The first word in the (3x) input data block contains input data necessary for user logic to efficiently control the ZAE 201; it comprises three parts:

- A one–bit module busy flag
- A set of seven error condition bits
- A set of eight mode–specific module status bits

The following diagram shows the first word in the input data block.



* indicates that the bit value may be either 1 or 0 when the module is in this state.

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The second and third words in the input data block contain the latest count or position value, depending on the operating mode of the module. The second word contains the high order position or count, and the third word contains the low order. The following is an explanation of bits 10 ... 13 in the above illustration:

Bit 10	In position mode, a 1 in this bit indicates whether the motion is within the specified target range
Bit 11	The state of relay 2 at terminal 18
Bit 12	The state of relay 1 at terminal 16
Bit 13	The state of FKE input at terminal 14

Note: When in position mode the counts are 4 times those counts when in counter mode.

Format of the Output Data Block

The first 4x word in the output data block passes commands to the ZAE 201 module. It uses its low byte (bits 9 ... 16) to indicate the command type; the high byte (bits 1 ... 8) is not used. The command types and their output data block implementations are mode dependent.
The following table is an output data block representation of counter/positioner commands:

Operating Mode	Command	Hex Value	Low Byte Bit Values
Counter	parameterize	01	0 0 0 0 0 0 0 1
	reset	02	0 0 0 0 0 0 1 0
	clear current count	03	0 0 0 0 0 0 1 1
Positioner	parameterize	01	0 0 0 0 0 0 0 1
	reset	02	0 0 0 0 0 0 1 0
	run reference	04	0 0 0 0 0 1 0 0
	run reference +	05	0 0 0 0 0 1 0 1
	go to target	06	0 0 0 0 0 1 1 0

These commands initiate a process to be carried out by the module and causes the module to change state, sometimes permanently and sometimes temporarily.
The second and third words in the output data block are command dependent. Sometimes they are used to pass needed information to the ZAE 201; other times they may not be used at all. Some commands require more information than can be stored in two words, and in these cases the second word is used as a pointer into state RAM where the requisite number of registers is accessed.

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47.2 Using the ZAE 201 Counter/Positioner Module as a High-Speed Counter

At a Glance

Purpose

This section provides an overview of the using the ZAE 201 Counter/Positioner Module as a high-speed counter.

What's in this Section?

This section contains the following topics:

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Field Wiring the ZAE 201 for Counting Applications	564
Switch Settings for Using the ZAE 201 as a High-Speed Counter	567
Overview of ZAE 201 Counter Mode Commands and States	568
ZAE 201Counter Mode Commands	569
Example: Using the ZAE 201 as a High-Speed Counter	572

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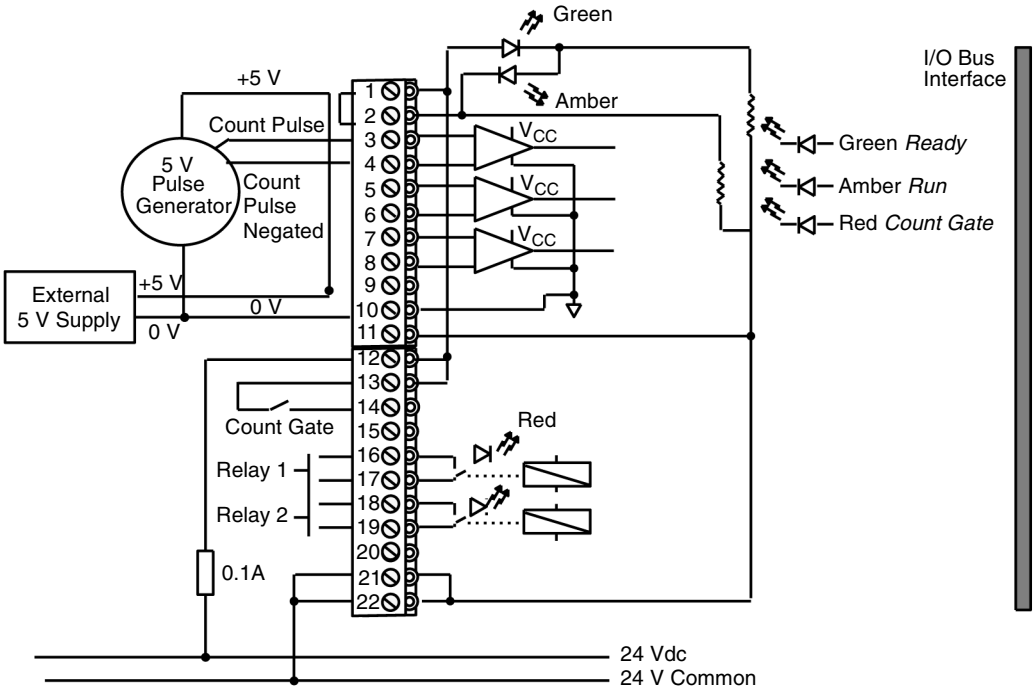
Field Wiring the ZAE 201 for Counting Applications

Field Wiring for Counting Applications

The ZAE 201 module can be field wired for counting applications in three different ways—for 5 V inputs and for 24 V inputs with or without the power monitor jumpered between terminals 1 and 2.

Wiring for Counting with 5 V Inputs

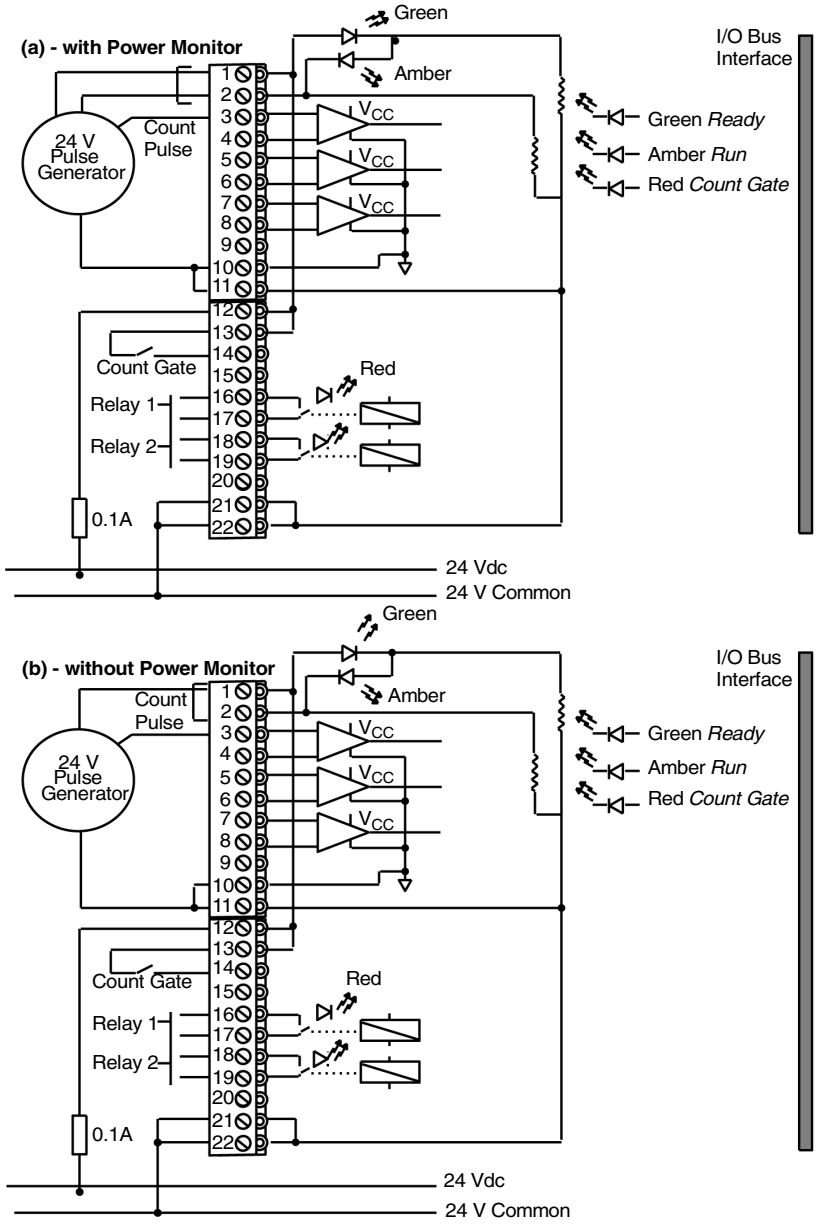
The ZAE 201 can be field wired for counting with 5 V inputs as shown below.



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Wiring for Counting with 24 V Inputs

The ZAE 201 can be field wired for counting with 24 V inputs, with or without the power monitor jumpered between terminals 1 and 2 as shown below.



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Facts About Field Wiring for Counting Applications

Note: When the jumper between terminals 1 and 2 is removed and when both terminals are field wired, as they are in panel (a) of the previous figure, the amber LED opposite terminal 2 can be used as a power monitor for 24 V input signals. In all other cases, the jumper should be left installed, thus preventing the LED from turning on.

For 24 V operations, a pulse source for the count is field wired to terminal screw 3. For 5 V operations, a differential input is required; pulse source and pulse source must be field wired to terminal screws 3 and 4, respectively. This source is a series of pulses generated by the events being counted.

The counter gate is field wired to terminal screw 14. This gate is used to control the counting operation. When the module is in the READY state and the count gate goes active, the current count held in the data input block is set to 0 and the module starts accumulating a new count.

The two relays that will receive your counter control logic are wired at terminal screws 16 and 18. Counter control logic is very application specific. For example, relay 1 at terminal screw 16 might be connected to an indicator light that is programmed to turn ON when a specified count is reached; at the same time, relay 2 at terminal screw 18 might be used to modify some aspect of the operation being counted when some other count is reached.

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Switch Settings for Using the ZAE 201 as a High-Speed Counter

Procedure for Setting Switches

To set a ZAE 201 module up as a high speed counter:

Step	Action
1	Place DIP switch B2 on the back of the module in the left (L) position.
2	Use DIP switch B1 to specify the desired input voltage at the count pulse inputs.
3	Use DIP switch B3 to specify whether the counter gate activity will be HIGH or LOW.

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Overview of ZAE 201 Counter Mode Commands and States

Parameterization

When the ZAE 201 has been installed as a counter module and the Compact-984 Controller has been powered up, the ZAE 201 comes up in a NET IN state. In the NET IN state, the module is able to accumulate pulse counts and store current count information in the second and third word of the input data block. The ZAE 201 must be given a set of counter mode parameters before the count gate and relays can operate.

Two parameters—P1 and P2—must be passed to the module. These two parameters are the count values at which relay 1 and relay 2, respectively, are to be either opened or closed. A third bit of information must also be passed to the module defining how the relays are to operate when the count is equal to P1 or P2.

READY and RUN States

Once the module has been parameterized, it goes into a READY state, where it is prepared for normal counting functionality controlled by the counter gate input. When the counter gate is active, the module is in the RUN state where it proceeds with its counting operation.

When the counter gate is not active, the module switches to the READY state where it stops counting and maintains the count that it has accumulated. Activating and deactivating the counter gate switches the module from READY to RUN and back.

RESET

If you need to change the operating parameters without stopping the controller, you can put the module back into a NET IN state at any time by issuing a RESET command.

Single Count and Multiple Count Operations

The relays can operate in either single or multiple count operations.An example of a single count operation might be using the P1 parameter is set to define when relay 1 opens—when the specified count is reached, the relay opens and the count continues.

An example of a multiple count operation might be a relay scheduled to open at a defined count and close when the count reaches 1.25 times the defined count. This operation will continue to open at every multiple of the defined parameter and close at every quarter multiple of that parameter.

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ZAE 201Counter Mode Commands

Counter Mode Commands

There are three commands that can be used in the counter mode—parameterize, clear current count, and reset. These commands are implemented in the three-word output data block specified in the I/O Map for the ZAE 201.As described in the following table, not all commands are acceptable at all times to the module:

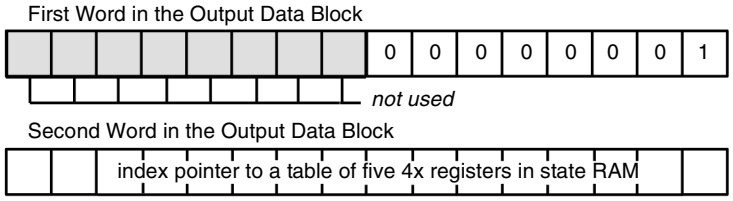
State	parameterize	clear current counter	reset
NET IN	allowed	allowed	allowed
READY	not allowed	allowed*	allowed
RUN	not allowed	not allowed	allowed
*** Allowed, but has no effect if the module has entered RUN state since being parameterized.**			

If a command is issued during a state that does not allow that command, an error is reported in the first word of the input data block.

Counter Mode Parameterize Command

The parameterize command implements the first two words in the output data block.

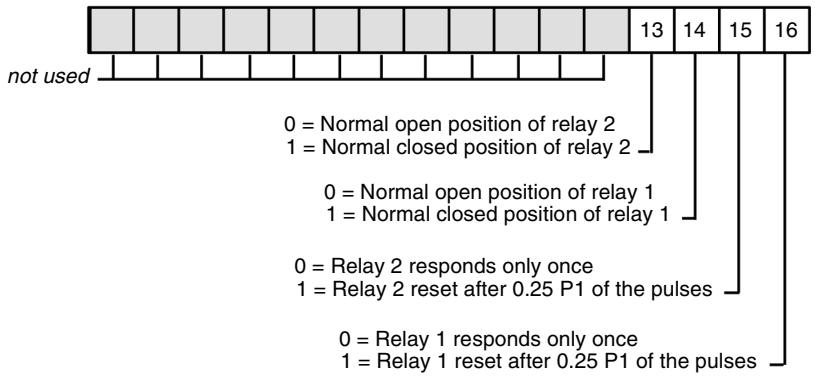
Output Data Block Format: parameterize Command in Counter Mode



The second word contains an index into a table of five 4**x** registers in the controller's state RAM. These five registers contain the information necessary to parameterize the module.
The first register in the 4**x** table contains information that defines how the relays will be set and how they will react when the count is met:

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The following diagram illustrates how the relays will be set and how they will react when the count is met.

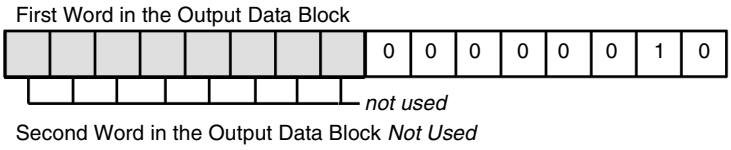


Any values that might appear in bits 1 ... 12 of the register are ignored.
The second and third registers in the 4**x** table contain a hexadecimal representation of P1, the count value controlling relay 1. The value of P1 < 8,388,607. The second register contains the high order part of the hex value, and the third register contains the low order part of the hex value.
The fourth and fifth registers in the 4**x** table contain a hexadecimal representation of P2, the count value controlling relay 2. The value of P2 < 8,388,607. The fourth register contains the high order part of the hex value, and the fifth register contains the low order part of the hex value.
If an error occurs during the issue of the **parameterize** command, the appropriate code will be returned in the first word of the input data block.

Counter Mode reset Command

The reset command implements only the first word in the output data block.

Output Data Block Format: reset Command in Counter mode



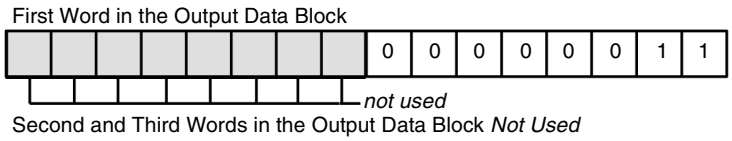
There are no errors associated with this command. If the module is in a RUN or READY state when the reset command is issued, the module will be put into a NET IN state. If the module is already in NET IN when the command is issued, nothing will happen.

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Counter Mode clear current count Command

The clear current count command implements only the first word in the output data block, as shown in the graphic below.

Output Data Block Format: clear current count Command in Counter Mode



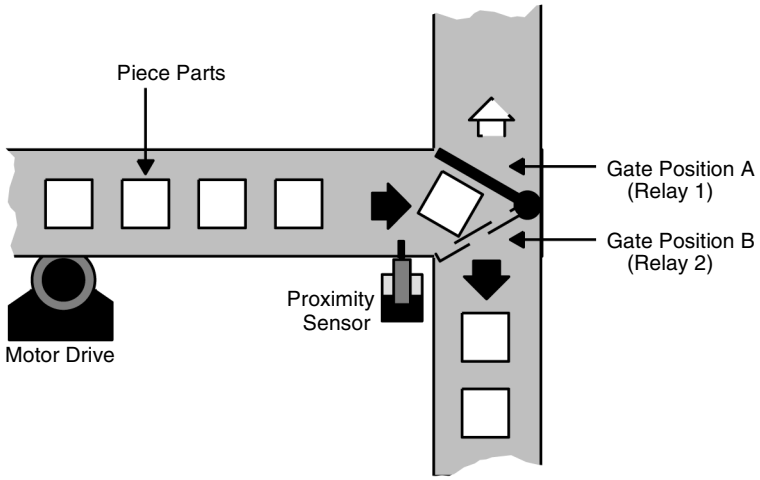
The only potential error associated with this command will be flagged if you issue it while the module is in RUN mode.

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Example: Using the ZAE 201 as a High-Speed Counter

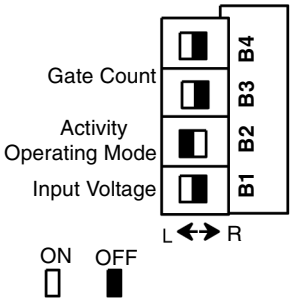
Overview

This system carries piece parts along a motor-driven conveyor line. The line continues to a diverting mechanism that sends parts to either the right (R) or left (L) into separate bins. The ZAE 201 Counter will enable the system to be controlled such that the gate will switch positions after every 4,000 pieces.
The following diagram illustrates a conveyer system application example.



Counter Example DIP Switch Settings

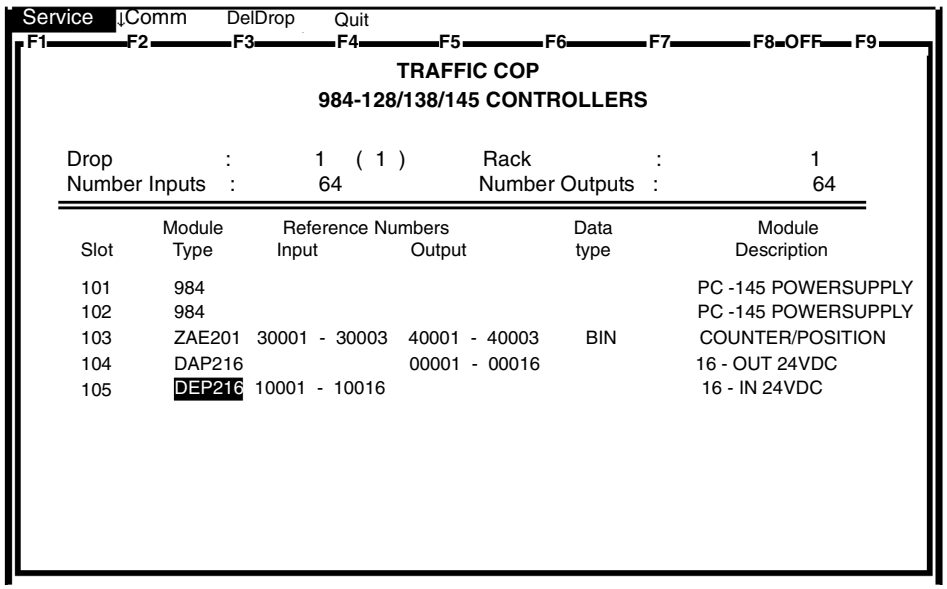
Set the DIP switches on the back of the module for COUNTER mode, 5 V input voltage, and LOW activity on the count gate.
The following diagram illustrates this procedure.



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Counter Example Traffic Cop Settings

Traffic cop the drop to support the system with the ZAE 201 high speed counter, a DAP 216 discrete output module, and a DEP 216 discrete input module:



Service ↓Comm DelDrop Quit

F1 F2 F3 F4 F5 F6 F7 F8-OFF F9

TRAFFIC COP
984-128/138/145 CONTROLLERS

Drop : 1 (1) Rack : 1
Number Inputs : 64 Number Outputs : 64

Slot	Module Type	Reference Numbers Input	Reference Numbers Output	Data type	Module Description
101	984				PC -145 POWERSUPPLY
102	984				PC -145 POWERSUPPLY
103	ZAE201	30001 - 30003	40001 - 40003	BIN	COUNTER/POSITION
104	DAP216		00001 - 00016		16 - OUT 24VDC
105	DEP216	10001 - 10016			16 - IN 24VDC

Counter Example Coil Use

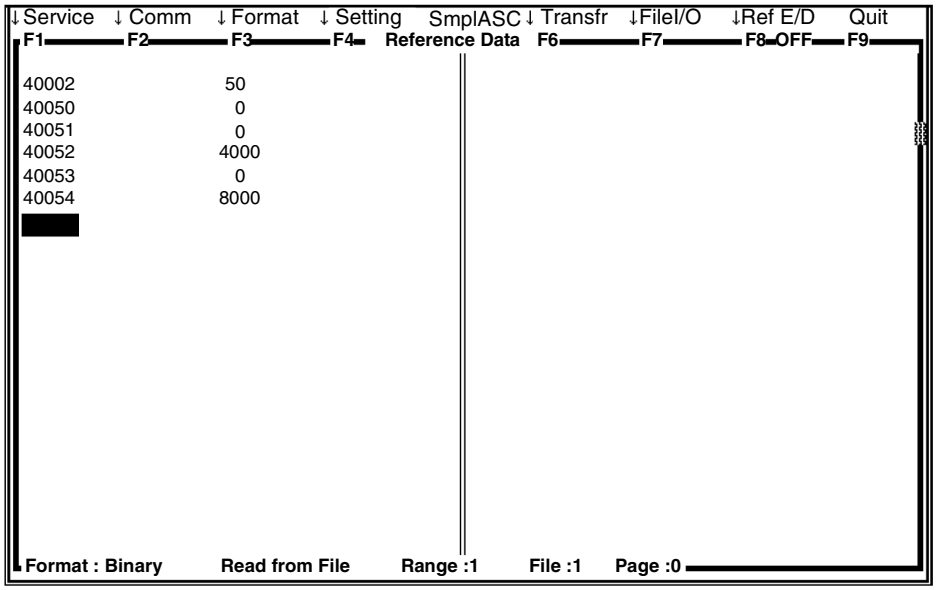
The following coils will be implemented in the example counting operation:

Usage	Coil	Function
External (DAP 216)	00001	Control coil for gate position A (at DAP 216 terminal screw 3)
	00002	Control coil for gate position B (at DAP 216 terminal screw 4)
	00007	Control coil for the count gate, the FKE input (at terminal screw 14)
Internal	00017	Logic solve coil—when ON, ladder logic is being solved
External (DEP 216)	10009	State of Relay 1 output from ZAE 201
External (DEP 216)	10011	State of Relay 2 output from ZAE 201

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Counter Example Parameterization

Go to the reference editor by pressing <ALT><F2>, and edit register values to parameterize the ZAE 201 high speed counter:



Set register 40002 to a decimal value of 50; this indicates a pointer to a block of five 4**x** registers starting at 40050. (Do not set values in register 40001 manually—this will be done by the user logic.)

The values you set in the table registers indicate:

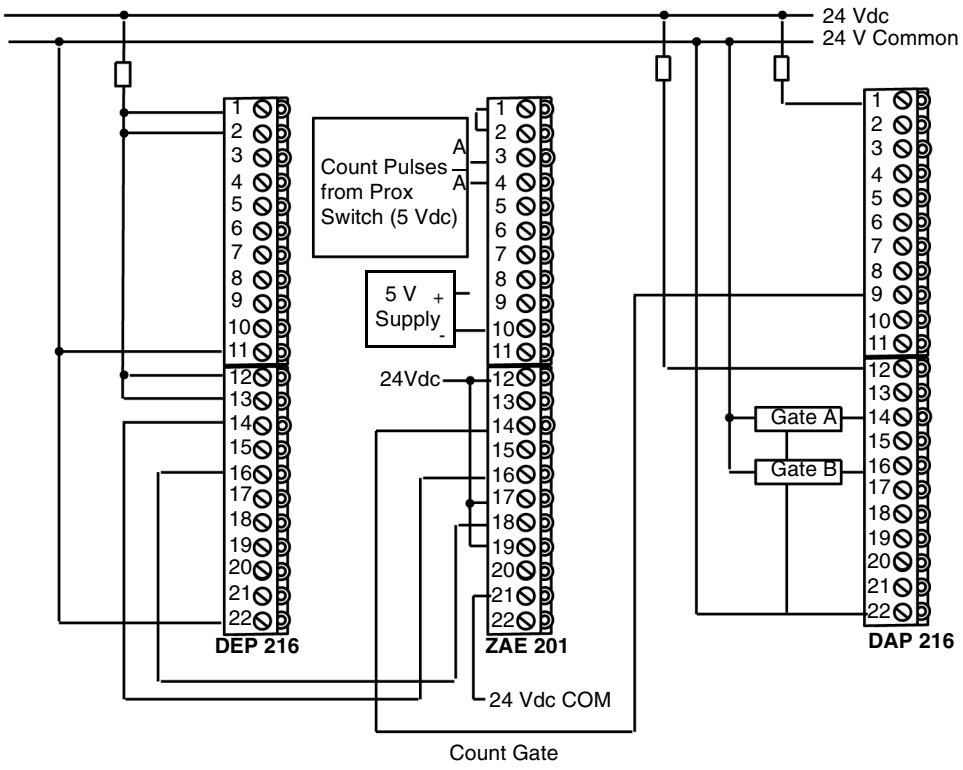
- Relays 1 and 2 are normally open and provide one–shot responses, since the four least significant bits in register 40050 are all set to 0
- The high order word value for relay 1, as expressed in register 40051, is 0
- The low order word value for relay 1, as expressed in register 40052, is 4,000 (FA0 in hex)
- The high order word value for relay 2, as expressed in register 40053, is 0
- The low order word value for relay 2, as expressed in register 40054, is 8,000 (1F40 in hex)

These parameterizing values will cause Relays 1 and 2 to close at the count values of 4000 and 8000, respectively.

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Counter Example Field Wiring Diagram

The discrete modules will be used to control the mechanics of the switching gate. Field wire the three A120 I/O modules like this:



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47.3 Using the ZAE 201 Counter/Positioner Module as a Positioning Controller

At a Glance

Purpose

This section provides an overview of the using the ZAE 201 Counter/Positioner Module as a positioning controller.
The ZAE 201 does not **control** speed, but provides relay outputs that indicate when speed should be changed. The actual control of speed must be provided by the user (ladder or hardware) logic—the module itself does not control the speed. Similarly, the ZAE 201 does not control direction; this is also a function of user-defined logic (ladder or hardware).

What's in this Section?

This section contains the following topics:

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Field Wiring for ZAE 201 Positioning Applications	577
Switch Settings for Using the ZAE 201 as a Positioning Controller	580
Overview of ZAE 201 Positioning Mode Commands and States	581
The ZAE 201 Positioning Mode Commands	582
Example: Using the ZAE 201 Module as a Positioner	588

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Field Wiring for ZAE 201 Positioning Applications

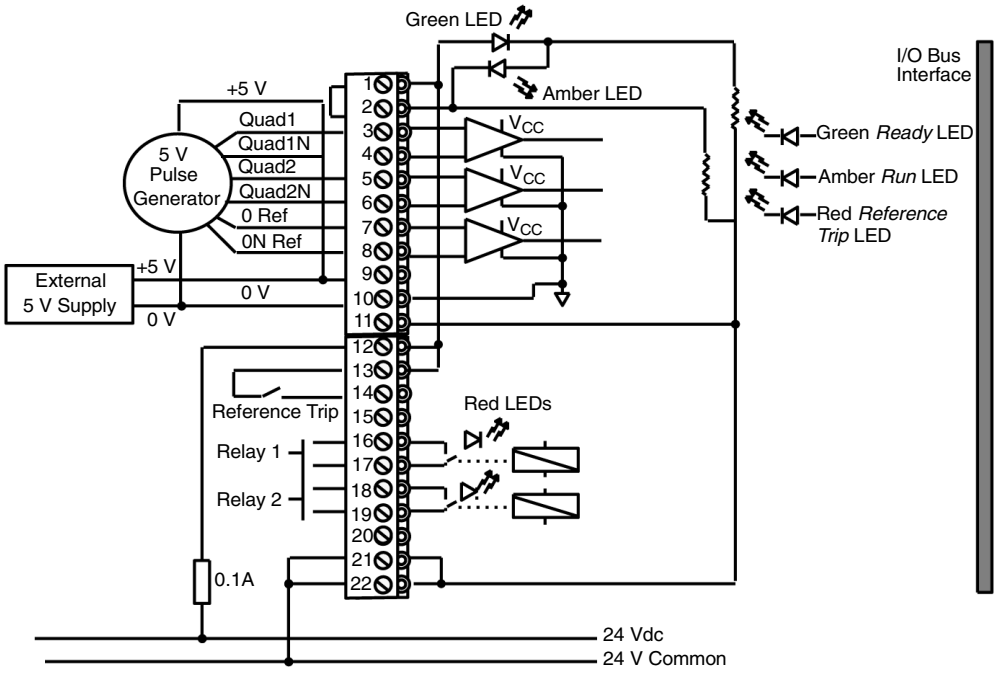
Field Wiring for Positioning Applications

The ZAE 201 module can be field wired for positioning applications in three different ways—for 24 V inputs with or without the power monitor jumpered between terminals 1 and 2, and for 5 V inputs.

> **Note:** When the jumper between terminals 1 and 2 is removed and when both terminals are field wired, as they are in Figure 18 (a), the amber LED opposite terminal 2 can be used as a power monitor for 24 V input signals. In all other cases, the jumper should be left installed.

Wiring a ZAE 201 Module for Positioning with 5 V Inputs

The ZAE 201 can be field wired for positioning applications with 5 V inputs as shown here.

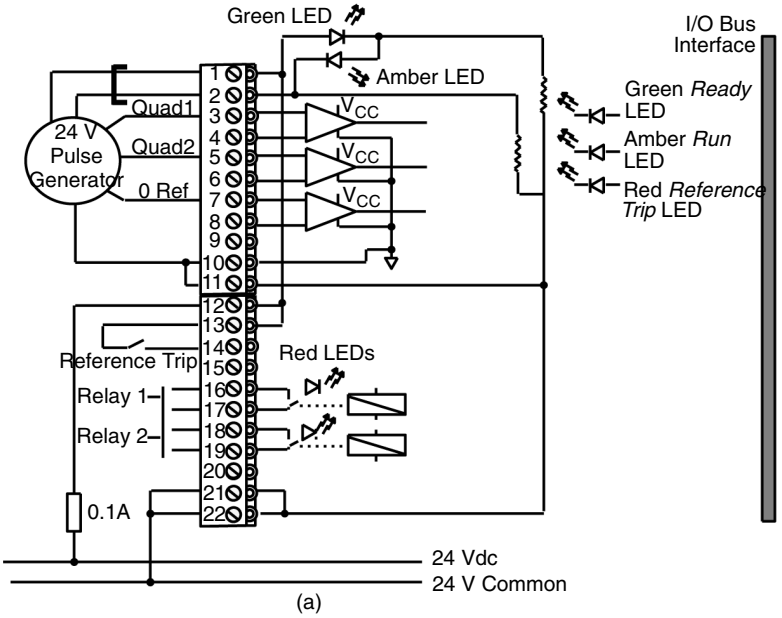


The direction of motion and speed are user defined. The ZAE 201 provides relay outputs that indicate when speed should be changed.

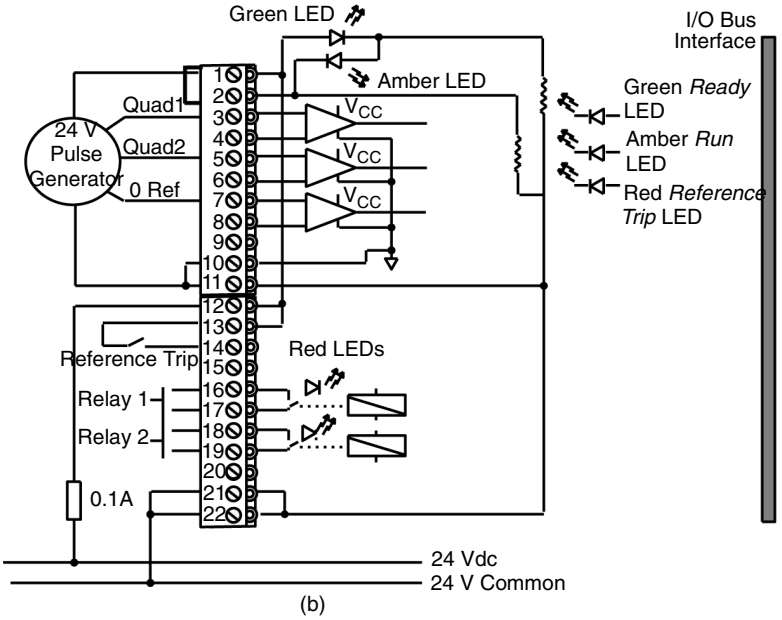
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Wiring a ZAE 201 Module for Positioning with 24 V Inputs

The ZAE 201 can be field wired for positioning applications with monitoring as shown in (a), and without (b).



(a)



(b)

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Position Control

For 24 V operations, a ZAE 201 positioning module requires three input signals from an incremental encoder to maintain absolute position—two quadrature pulse inputs connected at terminal screws 3 and 5 provide position and direction, and a third signal connected at terminal screw 7 provides a single pulse on every rotation of the encoder.

For 5 V operations, differential inputs are required; a ZAE 201 positioning module must be wired at six terminal screws:

- **Quad pulse 1** and **quad pulse 1** at terminal screws 3 and 4, respectively
- **Quad pulse 2** and **quad pulse 2** at terminal screws 5 and 6, respectively
- The **0 reference** and **0 reference** at terminal screws 7 and 8, respectively

The pulse signal combined with the reference trip input at terminal screw 14 define 0 for the linear travel route being controlled by the module.

The **reference trip input** is derived from the output of some type of proximity sensor placed at a position defined as 0. On command, the object under control is passed by the proximity switch. By logically ANDing the rotational pulse from the encoder with the signal from the proximity switch, you define 0 and maintain the position value of 0 within the module.

Position control is handled by user-defined discrete logic that controls a drive motor based on information provided by the Compact-984 Controller. Relays 1 and 2 on the ZAE 201 module control motor speed in the following manner, depending on whether the **parameterize** command has been set for overlapping mode or alternating mode pulse reception:

Overlapping Mode

- Both relays ON — fast speed
- Relay 1 OFF and relay 2 ON — slow speed
- Both relays OFF — stop drive motor

Alternating Mode

- Relay 1 ON and relay 2 OFF — fast speed
- Relay 1 OFF and relay 2 ON — slow speed
- Both relays OFF — stop drive motor

Motor direction must be controlled by other logic, typically by a discrete output module or ladder logic that drives a D/A converter—e.g., a DAU 202.

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Switch Settings for Using the ZAE 201 as a Positioning Controller

Switch Settings

To set a ZAE 201 module up as a one-axis positioning controller, place DIP switch B2 on the back of the module in the right (R) position, use DIP switch B1 to specify the desired input voltage at the encoder inputs, and use DIP switch B3 to specify whether the reference trip activity will be HIGH or LOW.
The ZAE 201's maximum allowable positions are limited to a range between -8,388,607 and +8,388,607.

Note: The ZAE 201 does not control speed, but provides relay outputs that indicate when speed should be changed. The actual control of speed must be provided by the user (ladder or hardware) logic-the module itself does not control the speed. Similarly, the ZAE 201 does not control direction; this is also a function of user-defined logic (ladder or hardware).

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Overview of ZAE 201 Positioning Mode Commands and States

Parameterization

When the ZAE 201 has been installed as a positioning module and the Compact-984 Controller has been powered up, the ZAE 201 comes up in a NET IN state. In the NET IN state, the module is unable to conduct any position control operations. It must be given a set of positioner mode parameters before it becomes a functioning module.

The process involves the setting of three positioning parameters—P1, P2, and P3—which describe how the two relays will manage motor speed as the target position is approached, These parameters are unsigned numbers that refer to three different distances from the target position.

For example, in overlapping mode, P1, P2, and P3 are values that must be defined based on the dynamics of the operation being controlled. When the distance from the target position reaches the value defined as P1, relay 1 is opened and the drive motor speed begins to be reduced. When the distance from the target position reaches the value defined as P2, relay 2 is opened and the drive motor is turned OFF; when the motor is turned OFF, the operation coasts to a stop. P3 defines an acceptable region on either side of the target position where you plan to stop the system.

Two additional bits of information must be passed to the module during the parameterization process. The first specifies the relay operation as a function of P1 and P2; the other specifies the speed at which the reference point will be approached.

Running a Reference Point

After the ZAE 201 has been parameterized for positioning mode, the module is not yet able to perform motion control until it has undergone a procedure called **running a reference point**. This procedure defines the 0-point on the axis of travel. It requires the issuing of the **run reference point** command in the output data block in order to drive the system toward the 0-position (defined by a proximity sensor) and set the position value in the module to 0 when that point is reached.

The direction of motion is totally user-controlled.

The READY State

After you have completed running a reference point, the ZAE 201 module enters the READY state for positioning operations. At this point, motion control can be enacted by simply requesting that the module drive the system to a particular coordinate.

RESET

If you need to change the operating parameters, you can put the module back into a NET IN state at any time by issuing a **reset** command.

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The ZAE 201 Positioning Mode Commands

Overview

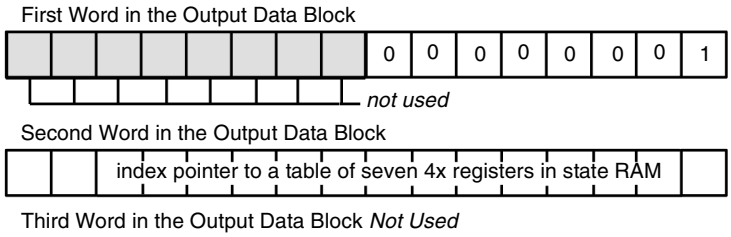
As shown in the following table, there are five commands that can be used in the positioning mode—**parameterize**, **reset**, **run reference point**, **run reference point +**, and **go to target**. These commands are implemented in the three-word output data block specified in the I/O Map for the ZAE 201. Before ordering encoders, ensure they comply with the A, B, and Z pulses shown in the Specifications section. Not all commands are acceptable at all times to the module:
The following table summarizes command and state compatibilities in positioner mode.

State	parameterize	reset	run ref	run ref +	go to target
NET IN	allowed	allowed	not allowed	not allowed	not allowed
PARAM	not allowed	allowed	allowed	not allowed	not allowed
READY	not allowed	allowed	not allowed	allowed	allowed
RUN FAST	not allowed	allowed*	not allowed	not allowed	not allowed
RUN SLOW	not allowed	allowed*	not allowed	not allowed	not allowed
RUN HUNT	not allowed	allowed*	not allowed	not allowed	not allowed
* Allowed but can cause current motion to stop by opening both relays.					

If a command is issued during a state that does not allow that command, an error is reported in the first word of the input data block.

Positioning Mode parameterize Command

The **parameterize** command implements the first two words in the output data block:
Output Data Block Format: parameterize Command in Positioner Mode

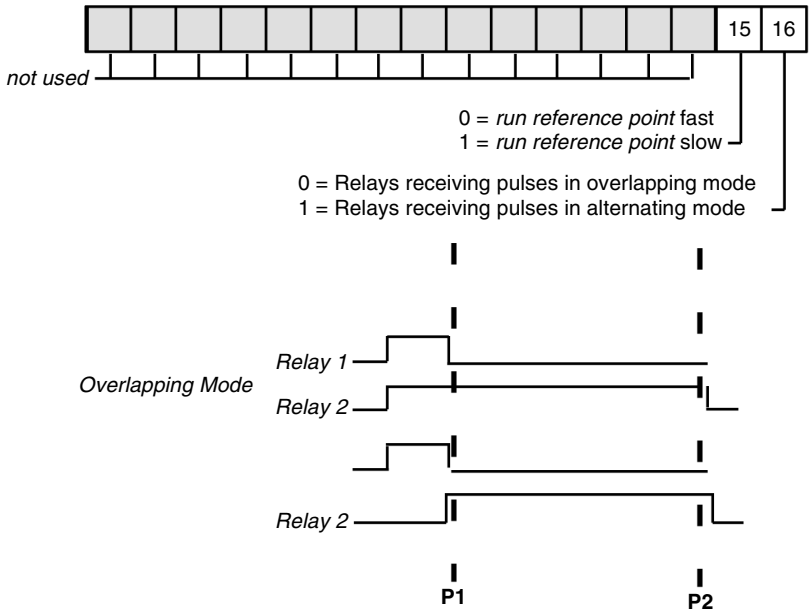


The second word contains an index into a table of seven 4**x** registers in the controller's state RAM. These seven registers contain the information necessary to parameterize the module.

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4[x] Table

The first register in the 4**x** table contains information that defines the operation of the relays during motion to a target position and the speed at which a **run reference point** is executed.
The following diagram illustrates this procedure.



Any values that might appear in bits 1 ... 14 of the register are ignored.
The second and third registers in the 4**x** table contain a hexadecimal number that defines P1—the distance from the target position at which the motor speed should slow down. The value of P1 < 8,288,607. The second register contains the high order part of the hex value; the third register contains the low order part of the hex value.
The fourth and fifth registers in the 4**x** table contain a hexadecimal number that defines P2—the distance from the target position at which the motor should turn OFF. The value of P2 < 8,288,606. The fourth register contains the high order part of the hex value; the fifth register contains the low order part of the hex value.
The sixth and seventh registers in the 4**x** table contain a hexadecimal number that defines P3—the distance from the target position that is deemed within acceptable tolerance of the desired position. The value of P3 < 8,288,605. The sixth register contains the high order part of the hex value; the seventh register contains the low order part of the hex value.

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Positioning Mode Motion Completion

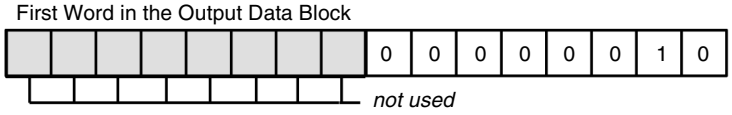
	**CAUTION** **Possible need to reset.** If the motion never achieves the target tolerance, the ZAE 201 will never report the motion completed—no further motion commands can be given without resetting the module. **Failure to follow this precaution can result in injury or equipment damage.**

Positioning Mode reset Command

The **reset** command implements only the first word in the output data block:

Output Data Block Format: *reset* Command in Positioner Mode

First Word in the Output Data Block



Second and Third Words in the Output Data Block *Not Used*

There are no errors associated with this command. If the module is in a RUN or READY state when the **reset** command is issued, the module will be put into a NET IN state. If the module is already in NET IN when the command is issued, nothing will happen.

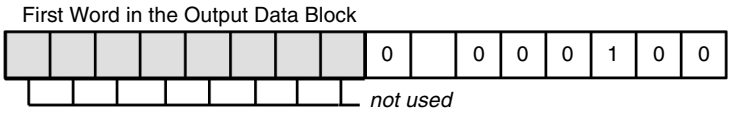
Note: The reset can be used as an emergency stop for any motion.

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Positioning Mode run reference point Command

The **run reference point** command is used to define a 0-point along the range of motion available to the system being controlled. The system is driven in the direction of a 0-point that has been predefined by a proximity sensor before issuing the command. When the system reaches the 0-point, the module defines its 0 reference location as this point.
The **run reference point** command implements only the first word in the output data block:

Output Data Block Format: *run reference point* Command in Positioner Mode



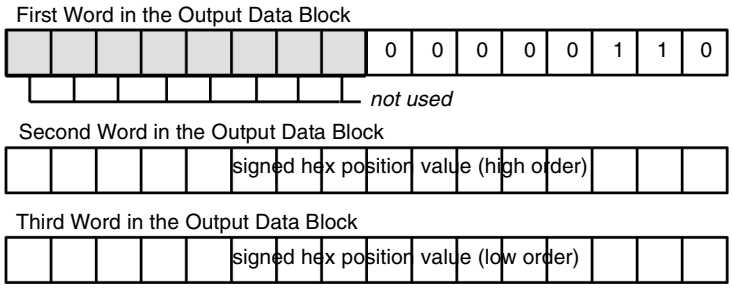
Second and Third Words in the Output Data Block *Not Used*

This command must be issued as part of the parameterization process and is valid only when the module is in a parameterized but not READY state.

Positioning Mode go to target Command

The **go to target** command is the major motion command used in the positioning mode; it implements all three words in the output data block:

Output Data Block Format: *go to target* Command in Positioner Mode



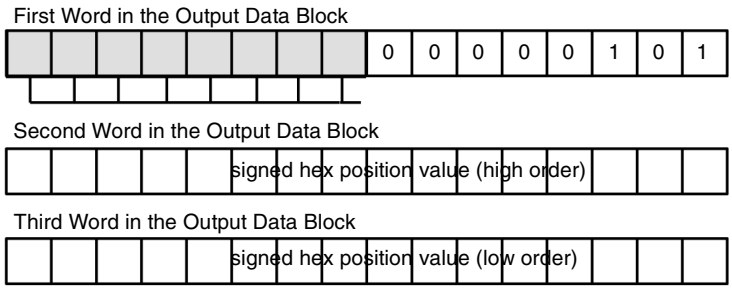
When you issue the **go to target** command, you tell the ZAE 201 module to drive the system under control to a position specified by a hexadecimal number entered in the second and third words of the output data block. The value of that hex number is in the range -8,388,608 ... +8,388,607. The direction of motion may be positive or negative; anticipated direction must be specified in user logic and transmitted to the position control logic during the same cycle that the **go to target** command is issued.When a **go to target** command is received, bit 1 in the first word of the input data block is set to 1; the bit remains set until the target is reached and the READY state is reached. No further motion commands are permitted while the busy bit is set.
The **go to target** command is valid only while the ZAE 201 is in the READY state.

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Positioning Mode run reference point + Command

The **run reference point +** command implements all three words in the output data block:

Output Data Block Format: *run reference point* + Command in Positioner Mode



When you issue the **run reference point +** command, you tell the ZAE 201 module to drive the system under control in a positive direction to a position specified by a hexadecimal number entered in the second and third words of the output data block. The value of that hex number is in the range -8,388,608 ... +8,388,607. In order for this command to be satisfied, the system under control must be driven **through** the 0 reference point.

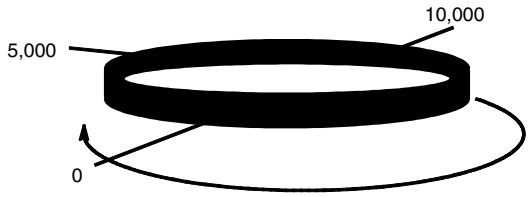
The **run reference point +** command is designed specifically for systems that continually return to the 0 reference point when driven in a positive direction—e.g., a continuous belt-driven machine. In this type of system, where all positions are defined as positive offsets of the predefined 0-point, the command may be used as an alternative to the **go to target** command for sending the system a target. If, for example, you want to move a system currently located at position 10,000 to target position 5,000, you may proceed to the target in either the positive or negative direction:

- To proceed in the negative direction, issue the **go to target** command to target position 5,000:



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- To proceed in the positive direction, issue the **run reference point +** command to target position 5,000:



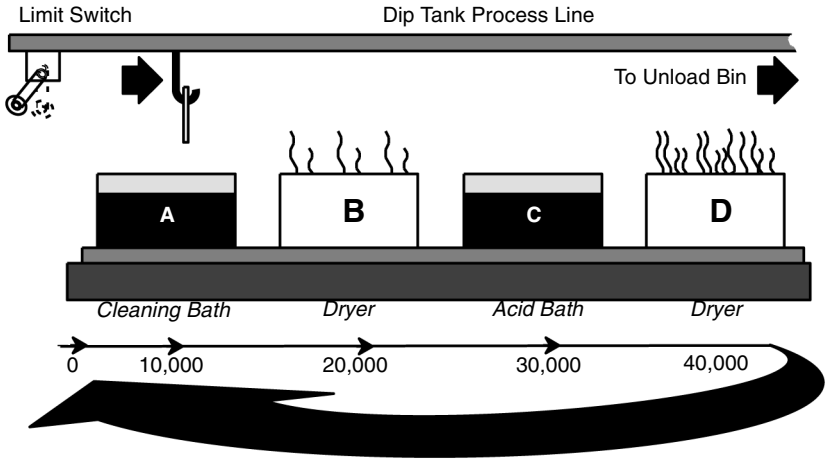
In the second case, the **run reference point +** command moves the system forward to the 0 reference point, resets the count to 0, then continues system movement positively to target position 5,000.
When a **run reference point +** command is received, bit 1 in the first word of the input data block is set to 1; the bit remains set until the target is reached and the READY state is reached. No further motion commands are permitted while the busy bit is set.
The **run reference point +** command is valid only while the ZAE 201 is in the READY state.

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Example: Using the ZAE 201 Module as a Positioner

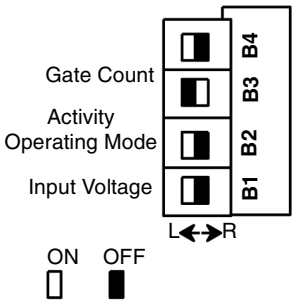
Positioning Example

The ZAE 201 module is used to control horizontal positioning in the following example. The system is a process line where printed circuit boards are dipped into a series of four tanks. In the positioning mode, the ZAE 201 carry the PCBs along the process line, position them over each of the four stations, and move them to the unload position at the end of the line. The example treats only the horizontal movement portion of the application; it does not treat vertical dipping motions.



Positioner Example DIP Switch Settings

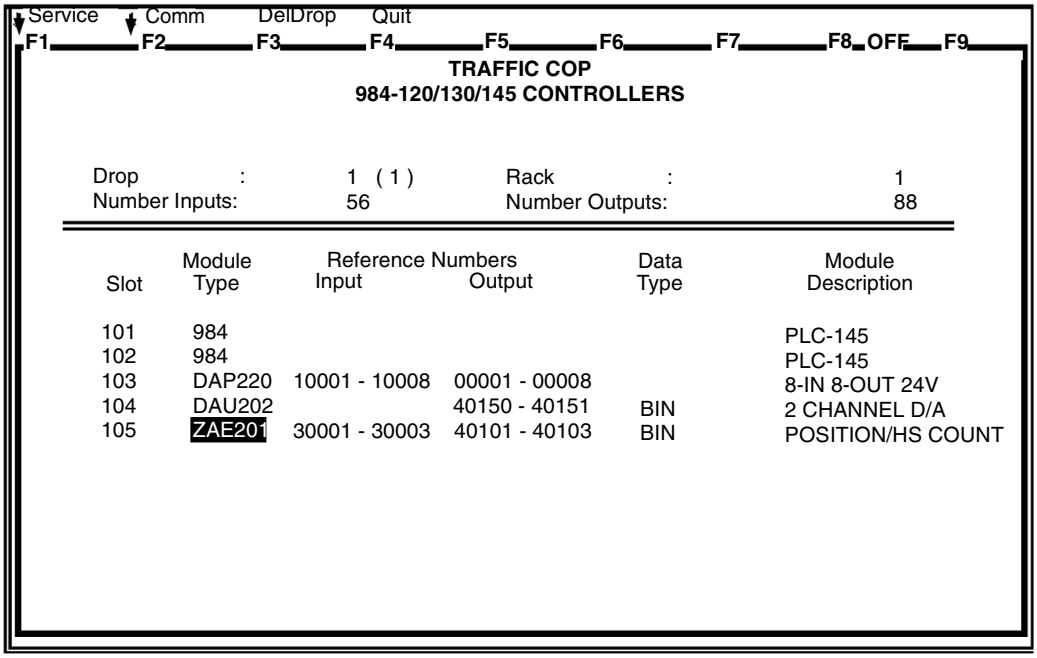
Set the DIP switches on the back of the module for POSITION mode, 5 Vdc input voltage, and HIGH activity on the count gate:



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Positioner Example Traffic Cop Settings

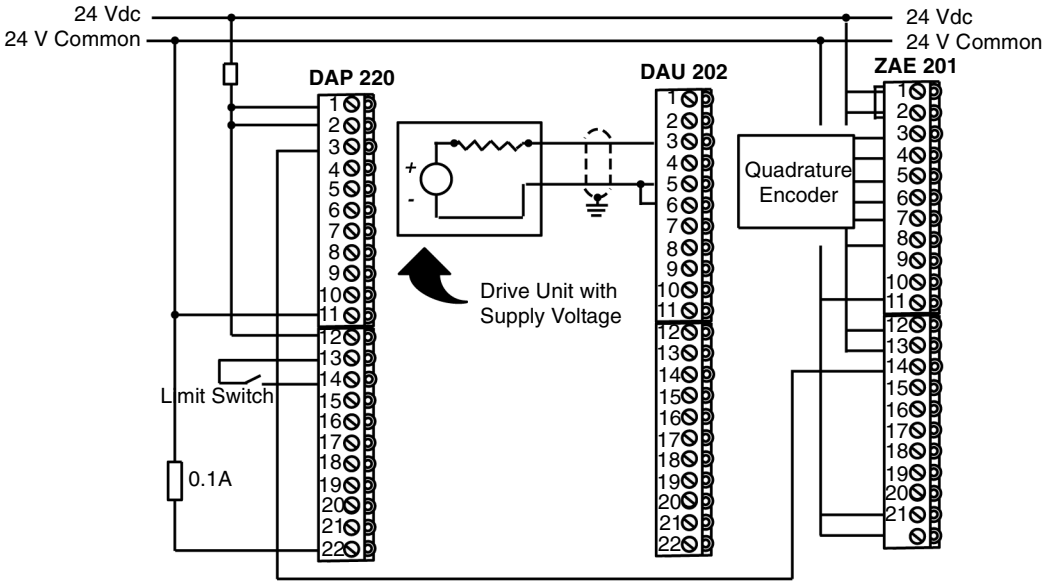
Traffic cop the drop to support the system with the ZAE 201 positioning module with a DAU 202 analog output module and a DAP 220 24 Vdc combo I/O module:



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Positioner Example Field Wiring Diagram

Field wire the two A120 I/O modules like this:



Positioning Example Ladder Logic

The following ladder logic program automatically parameterizes the module upon power-up and then repeatedly directs the motion:

- Relays 1 and 2 are normally open and provide one-shot responses, since the four least significant bits in register 40120 are all set to 0
- The high order byte value for P1—the distance from the target location at which the motor drive will begin to slow the process—is expressed in register 40121 as 0
- The low order byte value for P1 is expressed in register 40122 as 1,000
- The high order byte value for P2—the distance from the target location at which the motor drive will stop—is expressed in register 40123 as 0
- The low order byte value for P2 is expressed in register 40124 as 500
- The high order byte value for P3—the acceptable distance from the target location—is expressed in register 40125 as 0
- The low order byte value for P3 is expressed in register 40126 as 250

Positioning Example State RAM Values

The following values, initialized in State RAM, will enable the positioning example to operate using the logic, traffic cop, and module connections as described in the following tables.

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Data Blocks

Parameterize Data Blocks

40120	0	Parameterize Data
40121	0	P1 Value
40122	1000 Decimal	
40123	0	P2 Value
40124	500 Decimal	
40125	0	P3 Value
40126	250 Decimal	

Motion Direction Data Block

40130	32	These registers, when moved to call group 00001 - 00016, set Coil 10 or 11, specifying the direction of motion.
40131	32	
40132	32	
40133	32	
40134	32	
40135	64	
40099	0	Pointer to table of direction bits
40140	0	Pointer to table of motion commands
40100	1	Command data for parameterized command, pointing to a table starting with register 40120. This command will be active at the end of the first scan.
40101	120	
40102	0	

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Motor Speed, Direction, Motion Commands

Motor Speed And Direction Values

40160	4096 (+10 V)	One of these values is moved to register 40150, which is I/O mapped to the DAU 202. The output of the DAU 202 will control the motor speed and direction. NOTE: The specific values used here are application-dependent.
40161	3072 (+5 V)	
40162	2048 0	
40163	1024 (-5 V)	
40164	0 (-10 V)	

Motion Command Table

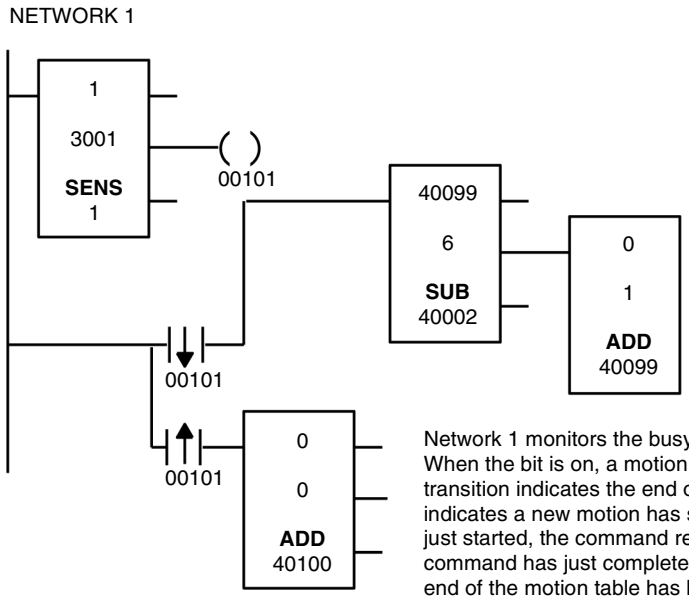
40200	4	Run reference point command data
40201	0	
40202	0	
40203	6	Move to position 10,000 command data
40204	0	
40205	2710 Hex	
40206	6	
40207	0	20,000
40208	4E20 Hex	
40209	6	
40210	0	30,000
40211	7530 Hex	
40212	6	
40213	0	40,000
40214	9C40 Hex	
40215	6	
40216	0	0
40217	0	

Positioning Example Network Diagrams

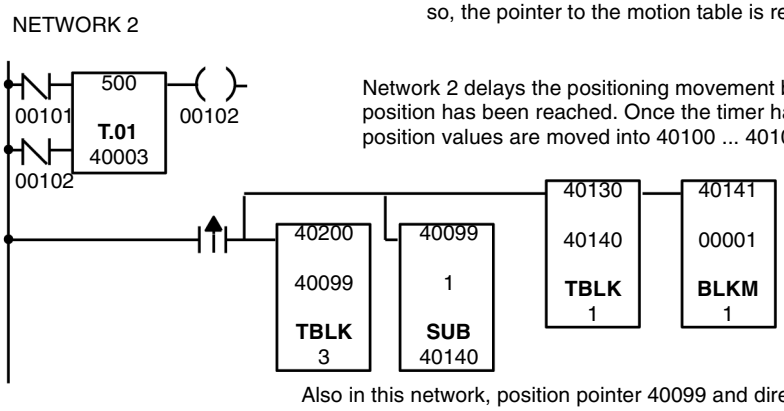
In the example shown here, the HOME proximity switch is simulated by disabling Coil 00001 and momentarily forcing it ON and then OFF, while the Run Reference Point command is being executed. This toggles the FKE input to the ZAE 201 via the DAP 220.

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Networks 1 and 2 The following diagram describes Networks 1 and 2.



Network 1 monitors the busy bit in status Register 30001. When the bit is on, a motion is in progress. A negative transition indicates the end of a motion; a positive transition indicates a new motion has started. If a new motion has just started, the command register is cleared. If the motion command has just completed, a check is made to see if the end of the motion table has been reached (40099 = 6); if so, the pointer to the motion table is reset to 1.



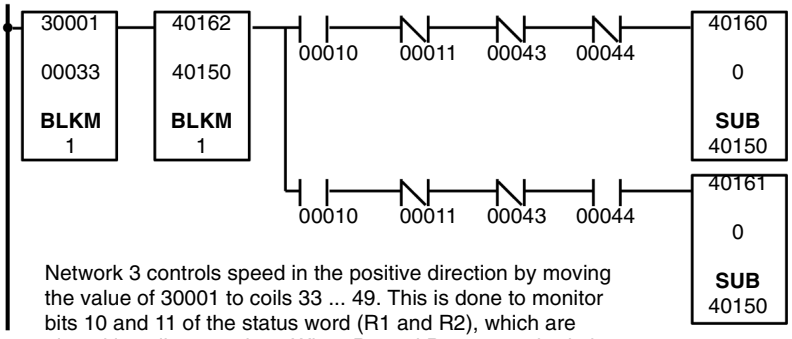
Network 2 delays the positioning movement by 5 s after each new position has been reached. Once the timer has timed out, the new position values are moved into 40100 ... 40102.

Also in this network, position pointer 40099 and direction pointer 40140 are incremented by 1 as part of the TBLK function block.

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Networks 3 and 4 The following diagram describes Networks 3 and 4.

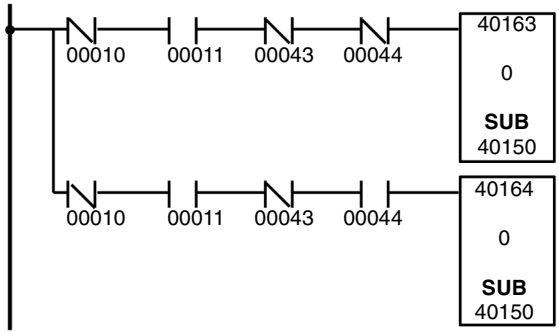
NETWORK 3



Network 3 controls speed in the positive direction by moving the value of 30001 to coils 33 ... 49. This is done to monitor bits 10 and 11 of the status word (R1 and R2), which are placed in coils 43 and 44. When P1 and P2 are reached, the system will change speeds appropriately (normal speed to slow speed, then slow speed to stop). Coils 10 and 11 define the direction of motion.

The BLKM of registers 40162 ... 40150 assumes no motion will occur. Subsequent logic sets up the appropriate speed.

NETWORK 4



Network 4 is similar to Network 3, but controls speed in the negative direction.

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47.4 Specifications of the ZAE 201 Counter/Positioner Module

Specifications of the ZAE 201 Counter/Positioner Module

Purpose

The purpose of this section is to list technical specifications of the module.

ZAE 201 Counter/ Positioner Specifications

Module Topology

Number of Relay Outputs	2
Operating Modes	Switch-selectable counter/positioner

Power Supplies

External Power Source (for all operating modes)	24 Vdc, 30 mA
Internal Power Source from I/O Bus	5 V, 100 mA maximum

Electrical Characteristics

Working Voltage Range of Relays		24 ... 60 Vdc
		24 ... 250 Vac
Contact Current (maximum)	Load Currents @ 230 Vac	2 A continuous resistive
		4 A instantaneous resistive
		1 A continuous (Cos Φ = 0.5)
	Load Currents @ 24 Vdc	2 A continuous resistive
		4 A instantaneous resistive
		1 A continuous (L/R* = 30 ms)
Wetting Current		5 mA (relay outs)
Contact Delay Time		~10 ms
Protective Circuitry		68 Ω + 15 nF in parallel with the contact Consumes ~1 mA
Maximum Wire Length	from 24 V Pulse Generator	20 m
		65 ft
	from 5 V Pulse Generator	50 m
		163 ft
* L = Load Inductance in H R = Load Resistance in Ω		

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Input Characteristics

5 V Input Selection	Differential RS-422	12 V peak-to-peak maximum
		400 mV peak-to-peak minimum
24 V Input Selection	for 1 signal	12 ... 30 V
	for 0 signal	-2 ... +5 V
Maximum Count Frequency	for 5 V input	500 kHz
	for 24 V input	50 kHz
PNP Encoder Quadrature type		Two-track plus marker signal
Count Gate/Reference Trip		1 = 12 Vdc (min)
		0 = 5 Vdc (max)
Encoder Pulse Alignment		See diagram below.
Duration		> 10 ms
Rise Time		N/A

Relay Contact Service Life

Mechanical Switching Cycles		20,000,000
Electric Switching Cycles (Resistive Load)	@ 230 Vac/0.2 A	10,000,000
	@ 230 Vac/0.5 A	7,000,000
	@ 30 Vdc/2 A, clamping diode	8,000,000 (typical)
	@ 60 Vdc/1 A with clamping diode	1,000,000 typical
		3,000,000 maximum
		3000 cycles/hr maximum
Electric Switching Cycles (Inductive Load, Cos Φ = 0.5)	@ 230 Vac/ 0.5 A	5,000,000

I/O Map

Register 3x/4x	3 in/3 out

Dimensions

W x H x D	40.3 x 145 x 117.5 mm
	1.6 x 5.6 x 4.5 in
Weight	300 g
	0.7 lb

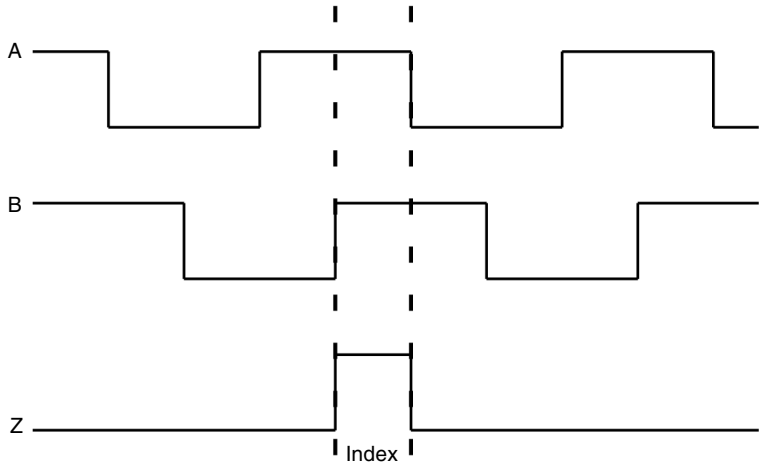
Agency Approvals

VDE 0160; UL 508; CSA 22.2 No.142; and FM Class I, Div 2 Standards

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Pulse Alignment of Encoders Used with the ZAE 201 Module

Encoders used with the ZAE 201 module should be ordered with the alignment of A, B and Z pulses as shown below.



Encoders used with the ZAE-201 module should be ordered with the alignment of A, B + Z pulses as shown above.

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