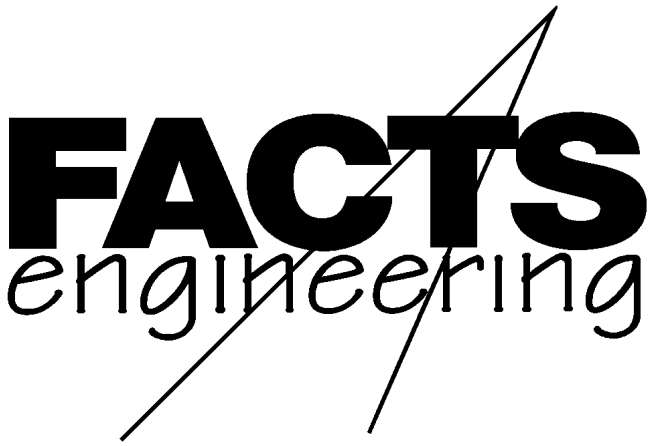

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Direct Logic 405

Magnetic Pulse Input Coprocessor

F4-8MPI

Manual Order Number: F4-8MPI-M

TRADEMARKS

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CHAPTER 1: INTRODUCTION

GENERAL DESCRIPTION

The 8-Channel Magnetic Pulse Input CoProcessor Module (MPICOP) is compatible with the Direct Logic 405 programmable controllers. The module is used to directly input pulses from magnetic pick-ups typically found on turbine meters and tachometer signal generators. Each input channel of the module may be configured to measure both volume of flow and flow rate in various engineering units. The module may also be configured to provide a direct indication of speed in engineering units such as RPM. Configuration data is stored in non-volatile V-Memory in the PLC. This permits easy updates over a network or with a local operator interface device.

HARDWARE AND SOFTWARE FEATURES

The differential pulse input channels have a wide operating range. This makes the Magnetic Pulse Input Module compatible with a wide range of pulse sources and pulse rates.

Eight independent input channels provide high count density for both cost and space savings. All eight channels may be read in one PLC scan using the high speed parallel dual port memory capability of the DL405 CPUs.

The module's automatic level adjustment circuitry eliminates the need for potentiometer adjustment.

The inputs are protected against power line shorts.

Input channels are optically isolated from the PLC logic.

User field wiring is made to a removable terminal block. Thus the module can be easily removed or changed without disrupting the wiring.

LED status indicators simplify troubleshooting and installation.

Built-in Battery-backed Calendar Clock for automatic data logging and time stamping.

The module scales data and reports values in Engineering units using the built-in floating point math facility. Volume and flow measurement calculations are carried out to 8 significant digits for high accuracy.

Floating point calculation results may have an implied decimal point. The value returned may contain from 0 to 8 digits to the right of the decimal point.

POWER SOURCE

The MPICOP is of low power CMOS design. External power supply requirement is 170 mA at +18 to +30
VDC. Maximum current draw from the 5 VDC CPU and base power supply is 225 mA maximum.

OPERATING MODES

Indicated Volume and Gross Volume

Configuration — The MPICOP calculates Indicated Volume of flow given a K Factor. The K Factor is the nominal pulses per unit for the flow meter. This is the factor calibration number normally stamped on the meter housing. Indicated Volume may be in pulses, gallons, dm3, or barrels depending on the K Factor.

Gross Volume may also be calculated by substituting for the K Factor, the K Factor divided by the Meter Factor (Meter Factor is calibration factor derived at the installation).

Output data — Total volume of flow is output to the PLC in engineering units. The formulas used to calculate volume are:

Indicated Volume = Total Pulses / K Factor

Gross Volume = Total Pulses / (K Factor/Meter Factor)

Volume Logging

Configuration — Indicated or Gross Volume may be logged at either a particular time or at periodic intervals throughout the day. If desired, the counters may be automatically reset when the data is logged. The built in real time battery-backed calendar clock must be set before volume logging is enabled.

Output data — Indicated or Gross Volume is output to the PLC in engineering units. A one-shot flag is also set to indicate to the PLC that new data has been logged.

Flow Rate

Configuration — The Flow Rate calculation uses the same configuration information as the Volume calculation.

The Sample Rate which may range from .1 to 999.9 seconds, or minutes must also be specified.

Output data — Flow rate is output to the PLC in engineering units. The formula used to calculate flow rate is:

(Volume last sample time - Current Volume) / Sample Rate

Tachometer

Configuration — Tachometer applications are simply a variation of the Flow Rate calculation. To calculate revolutions per minute, RPM, set the K Factor equal to the number of pulses per revolution times 60 and the Sample Rate equal to one second.

To calculate pulses per second, PPS, set the K Factor equal to one and the Sample Rate equal to one second.

Output data — RPM or PPS

MAGNETIC PULSE INPUT MODULE SPECIFICATIONS	
Number of Channels	8, Differential per module
Number of Modules per CPU	8 Maximum
Module Type	Intelligent, CCM COMM I/F MOD
Module Installation	Any slot in the CPU Base, single slot
Input Voltage Range	10 mV to 10 VDC peak
Input Frequency Range	dc to 5.0 KHz (Channels 1 to 4)
Maximum Continuous Overload	-150 to +150 VDC, 220 VRMS
Input Impedance	100 K Ω
Differential Low-Pass Filter	f-3db = 20 KHz, 6db per octave roll-off
Common Mode Voltage Range	±15 VDC
Common Mode Rejection	∞ over common mode input voltage range
Update Time	Three PLC scans minimum
Isolation	750 VDC, channels to PLC
Operating Temperature	0° to 60° C (32° to 140° F)
Relative Humidity	5% to 95% (non-condensing)
LED Status Indicators	Power ON, Input Pulse (8 LED's)
Field Wiring Connector	20 Position Removable Terminal Block 16 positions, ±CHn, Pulse Inputs 2 positions, 24 VDC power supply
Internal Power Consumption	225 mA from 5 VDC maximum
External Power Required	170 mA maximum, +18 to +25 VDC

CHAPTER 2: INSTALLATION AND WIRING

INSTALLATION

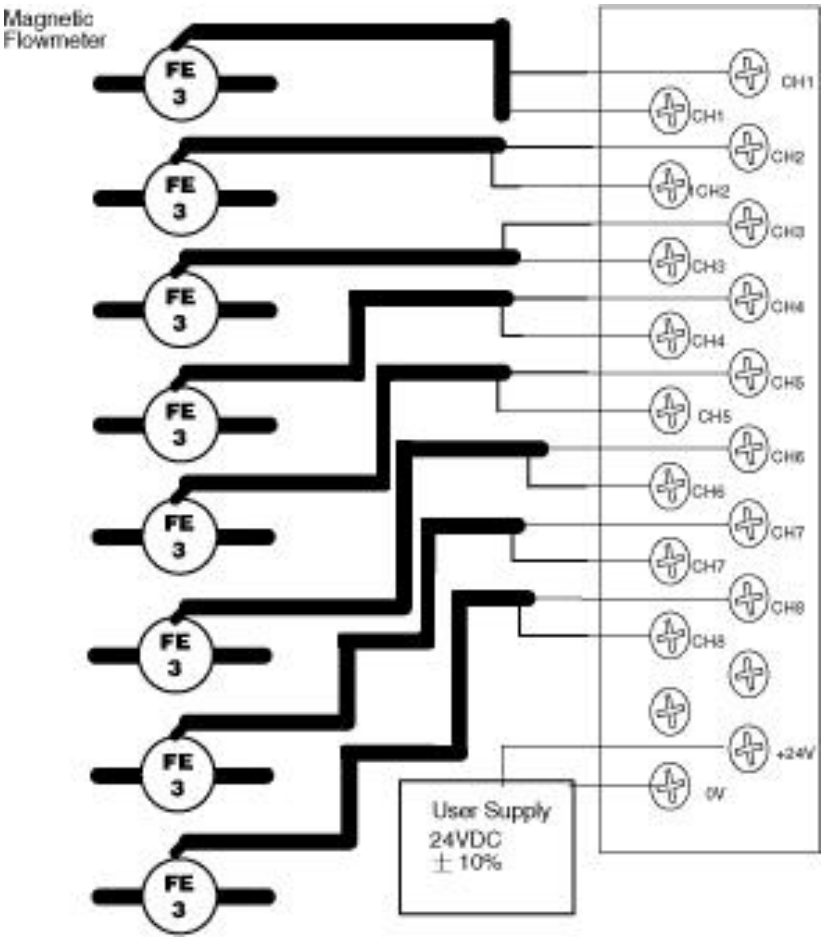
The Magnetic Pickup Input CoProcessor module, MPICOP, may be installed in any slot in a CPU base. Up to 8 modules may be installed in a single base. Because the MPICOP communicates with the PLC using the high speed parallel dual port ram intelligent module interface, the MPICOP may not be installed
in an expansion or remote base.

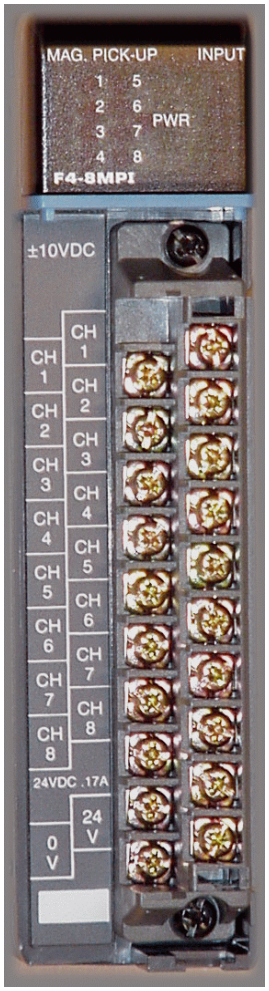
SLOT CONFIGURATION

The MPICOP reads all configuration out of and writes data into user V-Memory in the PLC. The starting address of the MPICOP's input channel configuration data must be specified by the user. Please see "MPICOP SLOT CONFIGURATION MEMORY MAP" on page 6.

INPUT CHANNEL CONFIGURATION

The memory map for input channel configuration is presented in Chapter 3. The ladder logic example in Chapter 4 demonstrates configuration, reading and resetting Indicated Volume, Flow Rate and the Real Time Clock. Chapter 1 contains a general description of the MPICOP's operating modes.





SENSOR WIRING REQUIREMENTS

1) Use shielded twisted pair wire from magnetic pick-up to module.

2) If the shield is split into sections, as might occur if connectors or terminal blocks are used, the shield for each segment must be tied to those for the adjoining segments.

2) Connect shield on sensor end only. Do not connect shield on module end.

3) Maintain the isolation between the magnetic pickup and frame or earth Ground. For correct operation, magnetic pickups must be floating.

4) Connect together inputs of unused channels to prevent false counting. See channels 2, 4, 6, and 8 in the diagram above.

5) To maintain the high common mode rejection of the differential inputs, each input must have only one connection. Do not connect inputs to ground. Do not connect either of the inputs to the 24 VDC power supply.

CHAPTER 3: V-MEMORY MAP

There can be up to 8 MPICOP modules per base. Each MPICOP has three dedicated V-Memory locations associated with it to specify the starting address of the configuration and data table, the number of pulse inputs enabled for that module, and a location for the module to return configuration error codes. Values in the MPICOP memory map are in BCD/HEX format.

DEDICATED V-MEMORY MAP

The dedicated V-Memory locations are only read by the MPICOP at power-up.

Each MPICOP configuration and data table is 64 V-Memory locations long (100 octal). The beginning address of the configuration and data table is specified by a V-Memory pointer stored in the slot dependent Table Beginning Address location shown below. If the Table Beginning Address is zero then the default address shown in parentheses is used. Normally put table in retentive V-Memory, V2000 - V7377.

Specify the actual number of pulse inputs used to reduce MPICOP update time. If the number of inputs enabled is zero then the default value of 8 is used.

Error Code contains a configuration error code plus the firmware revision level.

High Byte = Version Number
Low Byte = Configuration Error Codes

0 = Valid configuration
1 = Starting table address below user v-memory
2 = Starting table address too high
3 = More than 8 pulse inputs enabled
4 = Pulse Count Battery-backup failed or low

Example: A BCD Error Code of 1002 indicates the starting table address is too high and the firmware version is 1.0.

MPICOP SLOT CONFIGURATION MEMORY MAP

Slot Number	Table Beginning Address / (Default Address)	Number of Inputs Enabled	Error Code
0	V7350 / (V5000)	V7351	V7352
1	V7353 / (V5100)	V7354	V7355
2	V7356 / (V5200)	V7357	V7360
3	V7361 / (V5300)	V7362	V7363
4	V7364 / (V5400)	V7365	V7366
5	V7367 / (V5500)	V7370	V7371
6	V7372 / (V5600)	V7373	V7374
7	V7375 / (V5700)	V7376	V7377

Example: To specify V5000 as the configuration and data table beginning address for a MPICOP in slot 4, V7364 would contain the BCD number 5000. To enable all 8 pulse inputs for this module, V7365 would contain the number 8. The module will use all V-Memory locations from V5000 to V5077.

MPICOP CONFIGURATION AND DATA TABLE MEMORY MAP

Decimal Offset	Example V-Memory	Description	
Module Configuration - Decimal Offset 0-3, Read on Power Up and when Bit 0 of Mode Word is Set			
0	V5000	Sample rate = .1 to 999.9	
1	V5001	Roll-Over = 4,6, or 8 digits	
2	V5002	Log Control	10 = Log at Preset Time 11 = Log and Reset at Preset Time 20 = Log at Preset Interval 21 = Log and Reset at Preset Interval
3	V5003	Log Time = 00 to 23 hours	
Module Control Locations (Bit Mapped) - Decimal Offset 4-7, Read continually			
4	V5004	Status (bit mapped)	
5	V5005	Read Data (bit mapped)	
6	V5006	Reset Data (bit mapped)	
7	V5007	MPI Mode Word (bit mapped)	
Channel Data 8-23, Written continually, Volume/Flow Rate/Last Logged Volume/Last Logged Flow Rate/ Raw Counts			
8 9	V5010 V5011	Channel 1 least significant word (LSW) Channel 1 most significant word (MSW)	
10 11	V5012 V5013	Channel 2 LSW Channel 2 MSW	
12 13	V5014 V5015	Channel 3 LSW Channel 3 MSW	
14 15	V5016 V5017	Channel 4 LSW Channel 4 MSW	
16 17	V5020 V5021	Channel 5 LSW Channel 5 MSW	
18 19	V5022 V5023	Channel 6 LSW Channel 6 MSW	
20 21	V5024 V5025	Channel 7 LSW Channel 7 MSW	
22 23	V5026 V5027	Channel 8 LSW Channel 8 MSW	
Battery-backed Calendar Clock - Decimal Offset 24-31, Read/Written when Bit 9 or 15 of Mode Word is Set			
24	V5030	SECONDS = 00.00 TO 59.99 SECONDS	
25	V5031	HOUR | MINUTES = 00 - 23 HOURS | 00 - 59 MINUTES	
26	V5032	DAY = 01 - 07 DAY OF WEEK	
27	V5033	YEAR = 00 - 99 YEAR	
28	V5034	MONTH | DATE = 01 - 12 MONTH | 01 - 31 DAY OF MONTH	
29 30 31	V5035 V5036 V5037	Reserved for future feature enhancements	

MPICOP CONFIGURATION AND DATA TABLE MEMORY MAPS (continued)

Decimal Offset	Example V-Memory	Description
Channel Configuration - Decimal Offset 32-63, Read on Power Up and when Bit 0 of Mode Word is Set		
32	V5040	Channel 1 K Factor, LSW (pulses/Unit)
33	V5041	Channel 1 K Factor, MSW
34	V5042	MSB = No. of digits right of decimal point in K Factor LSB = No. of digits right of decimal point in volume of flow
35	V5043	MSB = No. of digits right of decimal point in flow rate LSB = Channel 1, flow rate units code
36	V5044	Channel 2 K Factor, LSW (pulses/Unit)
37	V5045	Channel 2 K Factor, MSW
38	V5046	MSB = No. of digits right of decimal point in K Factor LSB = No. of digits right of decimal point in volume of flow
39	V5047	MSB = No. of digits right of decimal point in flow rate LSB = Channel 2, flow rate units code
40	V5050	Channel 3 K Factor, LSW (pulses/Unit)
41	V5051	Channel 3 K Factor, MSW
42	V5052	MSB = No. of digits right of decimal point in K Factor LSB = No. of digits right of decimal point in volume of flow
43	V5053	MSB = No. of digits right of decimal point in flow rate LSB = Channel 3, flow rate units code
44	V5054	Channel 4 K Factor, LSW (pulses/Unit)
45	V5055	Channel 4 K Factor, MSW
46	V5056	MSB = No. of digits right of decimal point in K Factor LSB = No. of digits right of decimal point in volume of flow
47	V5057	MSB = No. of digits right of decimal point in flow rate LSB = Channel 4, flow rate units code
48	V5060	Channel 5 K Factor, LSW (pulses/Unit)
49	V5061	Channel 5 K Factor, MSW
50	V5062	MSB = No. of digits right of decimal point in K Factor LSB = No. of digits right of decimal point in volume of flow
51	V5063	MSB = No. of digits right of decimal point in flow rate LSB = Channel 5, flow rate units code
52	V5064	Channel 6 K Factor, LSW (pulses/Unit)
53	V5065	Channel 6 K Factor, MSW
54	V5066	MSB = No. of digits right of decimal point in K Factor LSB = No. of digits right of decimal point in volume of flow
55	V5067	MSB = No. of digits right of decimal point in flow rate LSB = Channel 6, flow rate units code
56	V5070	Channel 7 K Factor, LSW (pulses/Unit)
57	V5071	Channel 7 K Factor, MSW
58	V5072	MSB = No. of digits right of decimal point in K Factor LSB = No. of digits right of decimal point in volume of flow
59	V5073	MSB = No. of digits right of decimal point in flow rate LSB = Channel 7, flow rate units code
60	V5074	Channel 8 K Factor, LSW (pulses/Unit)
61	V5075	Channel 8 K Factor, MSW
62	V5076	MSB = No. of digits right of decimal point in K Factor LSB = No. of digits right of decimal point in volume of flow
63	V5077	MSB = No. of digits right of decimal point in flow rate LSB = Channel 8, flow rate units code

MODULE CONFIGURATION

Sample Rate (V5000)

The Sample Rate Word is at V-Memory offset address 0. This is V5000 in the example. The MPICOP reads Sample Rate when the configuration change bit 0 in the Mode Word (V5007) is set. The sample rate is a BCD value .1 to 999.9. Set bit 1 in the Mode Word to specify the sample rate value is in units of minutes.

Flow Rate = (Vol. @ Last Sample Time - Vol. @ this Sample Time) / Sample Rate

Roll-Over (V5001)

The Roll-Over Word is at V-Memory offset address 1. This is V5001 in the example. The MPICOP reads Roll-Over when the configuration change bit 0 in the Mode Word (V5007) is set. Roll-Over specifies the raw count at which the pulse counters will roll over to 0. Roll-Over contains the maximum number of BCD digits which will be counted, either 4, 6, or 8. The default is 8 digits.

Example, if Roll-Over contains 0006 then the pulse counters will roll over from a count of 999999 to 0. Whenever the counter rolls over, the corresponding bit in the Status Word is set. This bit should be cleared by the PLC so that subsequent roll-overs can be recognized.

Log Control (V5002)

The Log Control Word is at V-Memory offset address 2. This is V5002 in the example. The MPICOP reads Log Control when the configuration change bit 0 in the Mode Word is set. Log Control is used to specify automatic Volume of Flow logging based on a preset time of day or a preset time interval. Valid Log Control values are:
10 = Log at Preset Time of Day
11 = Log and Reset at Preset Time of Day
20 = Log at Preset Time Interval
21 = Log and Reset at Preset Time Interval

When the Log Control preset time is reached the current Volume of Flow for all enabled channels is logged in non-volatile memory in the MPICOP. Whenever enabled by the Read Data Word (V5005), the last logged Volume of Flow or Flow Rate data is written to Channel Data (V5010-V5027).

When Log Control specifies Time of Day mode then the preset time is reached when the Battery-backed calendar clock hour first matches the value in Log Time (V5003).

When Log Control specifies Time Interval mode then the preset time is reached when the Battery-backed calendar clock hour is equal the amount specified in Log Time (V5003) plus the Battery-backed calendar clock hour of the last data logging.

Log Time (V5003)

The Log Time Word is at V-Memory offset address 3. This is V5003 in the example. The MPICOP reads Log Time when the configuration change bit 0 in the Mode Word is set. Log Time is used to specify in hours either the time of day or the time interval used for automatic Volume logging. Log time is a BCD value in the range 0 to 23.

BIT MAPPED V-MEMORY

Status Word (V5004)

The Status Word is at V-Memory offset address 4. This is V5004 in the example. Roll-over status bits are
set by the MPICOP and must be cleared by the PLC. Reset Logged data bits are set by the PLC and cleared by the MPICOP.

Hexadecimal Weight	Bit Number	Description
1	0	1 = Counters rolled over for Channel 1
2	1	1 = Counters rolled over for Channel 2
4	2	1 = Counters rolled over for Channel 3
8	3	1 = Counters rolled over for Channel 4
10	4	1 = Counters rolled over for Channel 5
20	5	1 = Counters rolled over for Channel 6
40	6	1 = Counters rolled over for Channel 7
80	7	1 = Counters rolled over for Channel 8
100	8	1 = Reset Logged Volume and Logged Flow Rate Channel 1
200	9	1 = Reset Logged Volume and Logged Flow Rate Channel 2
400	10	1 = Reset Logged Volume and Logged Flow Rate Channel 3
800	11	1 = Reset Logged Volume and Logged Flow Rate Channel 4
1000	12	1 = Reset Logged Volume and Logged Flow Rate Channel 5
2000	13	1 = Reset Logged Volume and Logged Flow Rate Channel 6
4000	14	1 = Reset Logged Volume and Logged Flow Rate Channel 7
8000	15	1 = Reset Logged Volume and Logged Flow Rate Channel 8

Read Data Word (V5005)

The Read Data Word is at V-Memory offset address 5. This is V5005 in the example. Each Channel has
two bits in the Read Data Word.

Total Pulse Count (Volume of Flow), Flow Rate, Last Logged Total Pulse Count, and Last Logged Flow Rate for each channel is written to the PLC according to the table.

Read Total Pulse Count	Read Flow Rate	Data written to the PLC
On	Off	Total Pulse Count
Off	On	Flow Rate
Off	Off	Last Logged Total Pulse Count
On	On	Last Logged Flow Rate

Hexadecimal Weight	Bit Number	Description
1	0	1 = Read Total Pulse Count for Channel 1
2	1	1 = Read Total Pulse Count for Channel 2
4	2	1 = Read Total Pulse Count for Channel 3
8	3	1 = Read Total Pulse Count for Channel 4
10	4	1 = Read Total Pulse Count for Channel 5
20	5	1 = Read Total Pulse Count for Channel 6
40	6	1 = Read Total Pulse Count for Channel 7
80	7	1 = Read Total Pulse Count for Channel 8
100	8	1 = Read Flow Rate for Channel 1
200	9	1 = Read Flow Rate for Channel 2
400	10	1 = Read Flow Rate for Channel 3
800	11	1 = Read Flow Rate for Channel 4
1000	12	1 = Read Flow Rate for Channel 5
2000	13	1 = Read Flow Rate for Channel 6
4000	14	1 = Read Flow Rate for Channel 7
8000	15	1 = Read Flow Rate for Channel 8

Reset Data Word (V5006)

The Reset Data Word is at V-Memory offset address 6. This is V5006 in the example. All bits are set by the PLC and cleared by the MPICOP.

Hexadecimal Weight	Bit Number	Description
1	0	1 = Reset Total Pulse Count for Channel 1
2	1	1 = Reset Total Pulse Count for Channel 2
4	2	1 = Reset Total Pulse Count for Channel 3
8	3	1 = Reset Total Pulse Count for Channel 4
10	4	1 = Reset Total Pulse Count for Channel 5
20	5	1 = Reset Total Pulse Count for Channel 6
40	6	1 = Reset Total Pulse Count for Channel 7
80	7	1 = Reset Total Pulse Count for Channel 8
100	8	1 = Reset Flow Rate for Channel 1
200	9	1 = Reset Flow Rate for Channel 2
400	10	1 = Reset Flow Rate for Channel 3
800	11	1 = Reset Flow Rate for Channel 4
1000	12	1 = Reset Flow Rate for Channel 5
2000	13	1 = Reset Flow Rate for Channel 6
4000	14	1 = Reset Flow Rate for Channel 7
8000	15	1 = Reset Flow Rate for Channel 8

Mode Word (V5007)

The Mode Word is at V-Memory offset address 7. This is V5007 in the example.

Hexadecimal Weight	Bit Number	Description
1	0	1 =Instruct MPICOP to read module and channel configuration. This bit is cleared by the MPICOP after cofiguration data is read.
2	1	1 = minutes, 0 = seconds, flow Sample Rate units
4	2	1 = Enable flow rate calculation, 0 = Disable (faster updates)
8	3	1 = Enable nonvolatile counting, 0 = Reset on power up
10	4	1 = Fresh Channel Data, set by MPICOP. This bit is used for multiplexing when reading more than one type of data from the MPICOP. See Example in Chapter 4.
20 40	5 6	Reserved for future feature enhancements
80	7	1 = Data Logged, set by MPICOP. This bit can be monitored by the user's program to determine when Logged Data is available. The bit must be cleared by the user's program so the presence of the next log event can be determined.
100	8	1 = Fast PLC update mode (Raw Counts). Channel data is raw pulse count in BCD format. When this bit is set it overrides all bits in the Read Data Word
200	9	1 = Battery-Backed Cal. Clock data to PLC. This bit is cleared by MPICOP after the Clock data is written to the PLC.
400 800 1000 2000 4000	10 11 12 13 14	Reserved for future feature enhancements
8000	15	1 = Battery-Backed Clock data to MPICOP. This bit is cleared by MPICOPafter the Clock data is read from the PLC.

Channel Data (V5010-V5027)

Channel Data starts at V-Memory offset address 8 for Channel 1 and ends at V-Memory decimal offset address 23 for Channel 8. This is V5010 to V5027 in the example. Channel Data is a double word value. Channel data will contain either the Total Volume of Flow, the Flow Rate, or the Last Logged Volume of Flow as determined by the bits in the Read Data Word (V5005).

Indicated Volume of Flow = Total Pulses / K Factor

Flow Rate = (Vol. @ Last Sample Time - Vol. @ this Sample Time) / Sample Rate

The number of digits to the right of the implied decimal point is specified in the Channel Configuration Data
section of the table (V5040 to V5077).

Set bit 8 in the Mode Word (V5007) to output to Channel Data every scan, the total number of pulses counted.

Battery-backed Calendar Clock (V5030-V5035)

The data read from or written to the Battery-backed Calendar Clock is at decimal offset address 24 to 29 in the table. This is V5030 to V5035 in the example. Setting bit 14 in the Mode Word (V5007) will read the Battery-backed calendar clock data from the MPICOP and write it to the PLC at these locations. The MPICOP clears bit 14 after the data is written.

Setting bit 15 in the Mode Word (V5007) will read these locations in the PLC and write the Battery-backed
calendar clock data in the MPICOP. The MPICOP clears bit 15 after the data is read.

Channel Configuration (V5040-V5077)

The Channel Configuration Data begins at V-Memory decimal offset address 32 for channel 1 and ends at
63 for channel 8. This is V5040 to V5077 in the example. The MPICOP reads Channel Configuration Data when the configuration change bit 0 in the Mode Word (V5007) is set. Four configuration locations are used per channel.

The first two V-Memory locations are a double word which contains the K Factor in pulses per unit.

In the most significant byte of the third V-Memory location, specify the number of digits to the right of decimal point in the K Factor double word.

In the least significant byte of the third V-Memory location, specify the number of digits to the right of the decimal point in the double word volume of flow returned in Channel Data.

In the most significant byte of the fourth V-Memory location, specify the number of digits to the right of the decimal point in the double word flow rate returned in Channel Data.

In the least significant byte of the fourth V-Memory location, specify the units used to calculate the flow rate. Valid entries for flow rate units are:

01 = Units / Seconds
02 = Units / Minutes
03 = Units / hour
00 or 04 = Units / day

Configuration Example

Configure Channel 1 for a turbine flow meter with a K Factor of 991.40628 pulses per gallon.

Return Indicated Volume in gallons with two digit to the right of the decimal point. If power is lost, resume
pulse counting with the count at the time of loss of power.

Return flow rate in gallons per minute with six digits to the right of the decimal point.

Re-calculate the flow rate every 30 seconds.

Log the Indicated Volume at midnight every day. Reset the Indicated Volume at midnight.

Values read and written using BINARY format:

V5005 = xxxxxxx0xxxxxxx1 Read Channel 1 Indicated Volume
V5005 = xxxxxxx1xxxxxxx0 Read Channel 1 Flow Rate
V5005 = xxxxxxx0xxxxxxx0 Read Channel 1 Last Logged Volume
V5005 = xxxxxxx1xxxxxxx1 Read Channel 1 Last Logged Flow Rate
V5007 = xxxxxxx0xxxx110x

Values read and written using BCD/HEX format:

V5000 = 0300 Calculate average flow rate for 30 seconds
V5002 = 0011 Log once a day and reset total pulse count
V5003 = 0000 Log at Midnight
V5040 = 0628 K Factor = 991.40628 pulses per gallon
V5041 = 9914
V5042 = 0502 5 K Factor and 2 Volume digits to right of decimal point
V5043 = 0601 6 Flow Rate digits to right of decimal point
flow rate in gallons per seconds

The MPICOP engineering unit calculations are:

Indicated Volume of Flow = Total Pulses / K Factor

Gallons = Total Pulses / Pulses per Gallon

Flow Rate = (Gallons Last Sample Time - Gallons this Sample Time) / Sample Rate

Flow Rate = ((Last - Current) / 30 Seconds) X 60 Seconds/minute = Gallons/minute

CHAPTER 4: SUPPORTING LADDER LOGIC

Minimal ladder logic is required in most applications. The following ladder logic example demonstrates using most of the features of the MPICOP.

MULTIPLEXING LADDER LOGIC EXAMPLE

The following example demonstrates configuration, reading and resetting Indicated Volume, Flow Rate and the Real Time Clock. In this example, the module is installed in slot 0. The MPICOP may be installed in any slot in the CPU base by changing the module configuration in the initial stage, ISG S0.

In this example, V1400 is used as a user control word to trigger various operations. When V1400 is 0, the
multiplexing ladder executes. When V1400 is non-zero the multiplexing ladder is paused. When the multiplexing ladder executes, raw pulse counts are written to V6000-V6017, Indicated Volume is written to
V6020-V6037, Flow Rate is written to V6040-V6057, Logged Flow Rate is written to V7000-V7017, and Logged Indicated Volume is written to V7020-V7037.

The operation of the other V1400 codes are described in the table below.

V1400 Code	Operation
0	Continue Multiplexing
1	Read Module and Channel Configuration and Resume Multiplexing
2	Set bit 15 of the Mode Word to set the RTC from V5030-V5034 and Resume Multiplexing
4	Turn all bits of V5006 (Reset Data Word) ON to reset Indicated Volume and Flow Rate Values
5	Turn all bits of V5006 (Reset Data Word) OFF and Resume Multiplexing
6	Turn all bits in the high byte of V5004 (Status Word) ON to Reset Logged Indicated Volume and Flow Rate
7	Turn all bits of V5004 (Status Word) OFF and Resume Multiplexing
All other codes	Stop Multiplexing

Changing Module Configuration

1) Write the BCD values for the Sample Rate, V5000, and the Roll-Over, V5001, using BCD/HEX format. Using a larger value for Sample Rate will generate faster PLC updates. Optionally write BCD values to Log Control, V5002, and Log Time, V5003 .

2) Write a value of 1 to V1400 to trigger the MPICOP to Read the module configuration data and resume multiplexing.

Changing Channel Configuration

1) Write the BCD values for the K Factor for each channel. Also write the number of digits to the right of the decimal point in the K Factor, Volume of Flow, and Flow Rate. Finally write the Flow Rate Units Code, 1 for seconds, 2 for minutes, 3 for hours, or 4 for days. Values are written in BCD to the V-memory locations associated with each channel.

2) Write a value of 1 to V1400 to trigger the MPICOP to Read the module configuration data and resume multiplexing.

Setting the MPICOP Real Time Clock

1) Write a value of 9999 to V1400 to stop the multiplexing ladder from writing the MPICOP RTC.

2) Write the Time, Date, Year, and Day of Week to the V memory locations V5030 to V5034.

3) Write a value of 2 to V1400 to trigger the MPICOP to read the RTC data from V memory and resume multiplexing.

Writing the MPICOP Clock to PLC V memory (V5030-V5034)

This is done automatically by the PLC program multiplexing ladder as long as there is a value of 0 in V1400.

Raw Counts

When the multiplexing ladder executes, raw count values are written to double words beginning at V6000.

Ch 1	Ch 2	Ch 3	Ch 4	Ch 5	Ch 6	Ch 7	Ch 8
V6000	V6002	V6004	V6006	V6010	V6012	V6014	V6016

Indicated Volume

When the multiplexing ladder executes, indicated volume is written to double words beginning at V6020.

Ch 1	Ch 2	Ch 3	Ch 4	Ch 5	Ch 6	Ch 7	Ch 8
V6020	V6022	V6024	V6026	V6030	V6032	V6034	V6036

Current Flow Rate Data

When the multiplexing ladder executes, Flow Rate is written to double words beginning at V6040.

Ch 1	Ch 2	Ch 3	Ch 4	Ch 5	Ch 6	Ch 7	Ch 8
V6040	V6042	V6044	V6046	V6050	V6052	V6054	V6056

Logged Indicated Volume

When the multiplexing ladder executes, last Logged Indicated Volume of Flow is written to double words beginning at V7000.

Ch 1	Ch 2	Ch 3	Ch 4	Ch 5	Ch 6	Ch 7	Ch 8
V7000	V7002	V7004	V7006	V7010	V7012	V7014	V7016

Logged Flow Rate

When the multiplexing ladder executes, last Logged Flow Rate is written to double words beginning at V7020.

Ch 1	Ch 2	Ch 3	Ch 4	Ch 5	Ch 6	Ch 7	Ch 8
V7020	V7022	V7024	V7026	V7030	V7032	V7034	V7036

Stage Programming

The multiplexing ladder is written using stage programming. This method allows the program to be easily
broken up into a logical sequence of operations.

Stage ladder logic programming builds on the PLC CPU programmer's existing ladder skills. Stage helps the programmer write sequential ladder logic by eliminating the need for interlocking control relays. A Stage program is also easier for another programmer or maintenance person to follow and understand than non-stage ladder logic.

To gain the benefits of Stage and the 3 Stage instructions, initial stage, stage label, and jump coil, you only need to learn 3 rules. The rules of stage are:

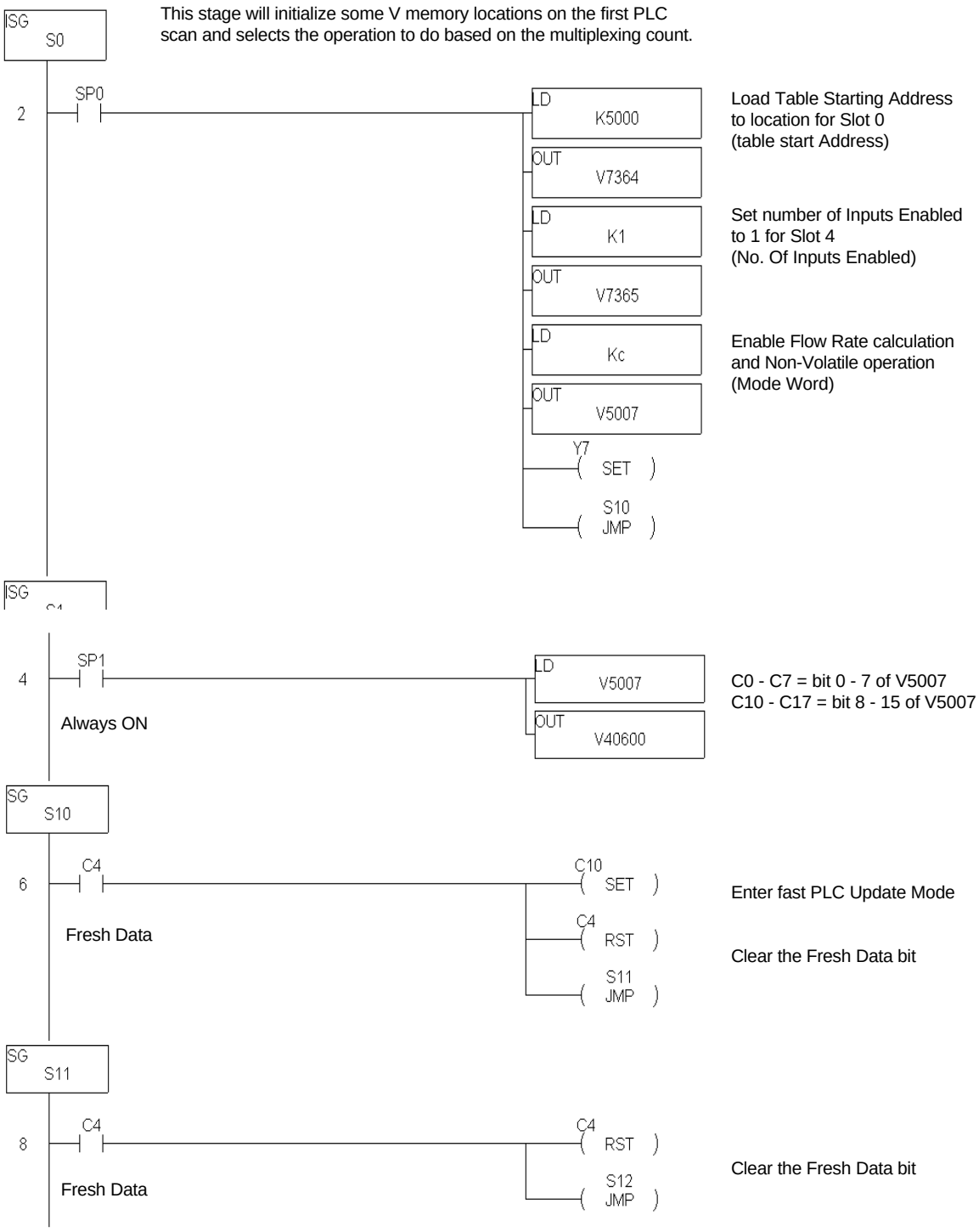
Rules of Stage

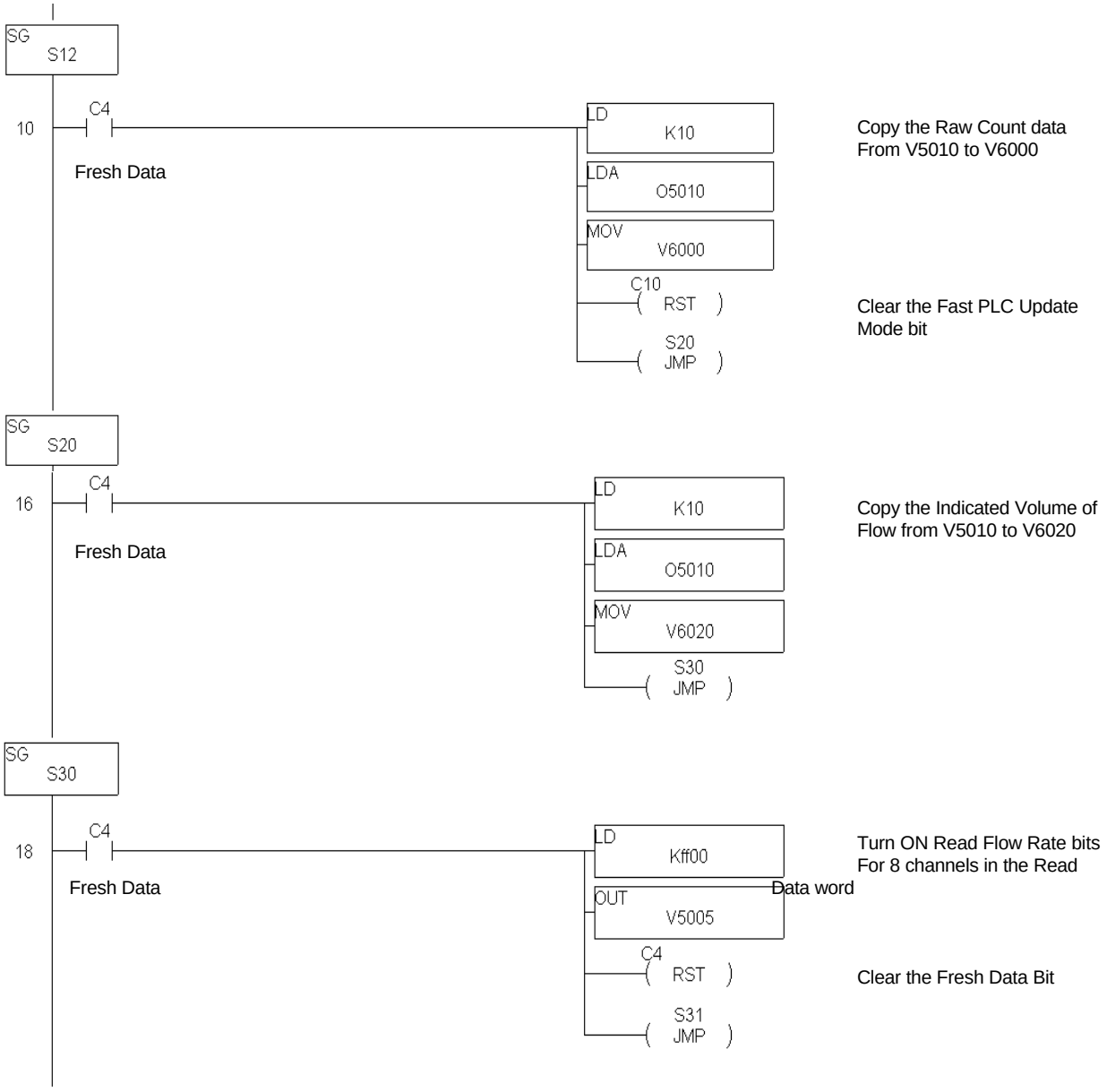
(1) Only the instructions in an active Stages are executed. Instructions in inactive Stages are not executed.

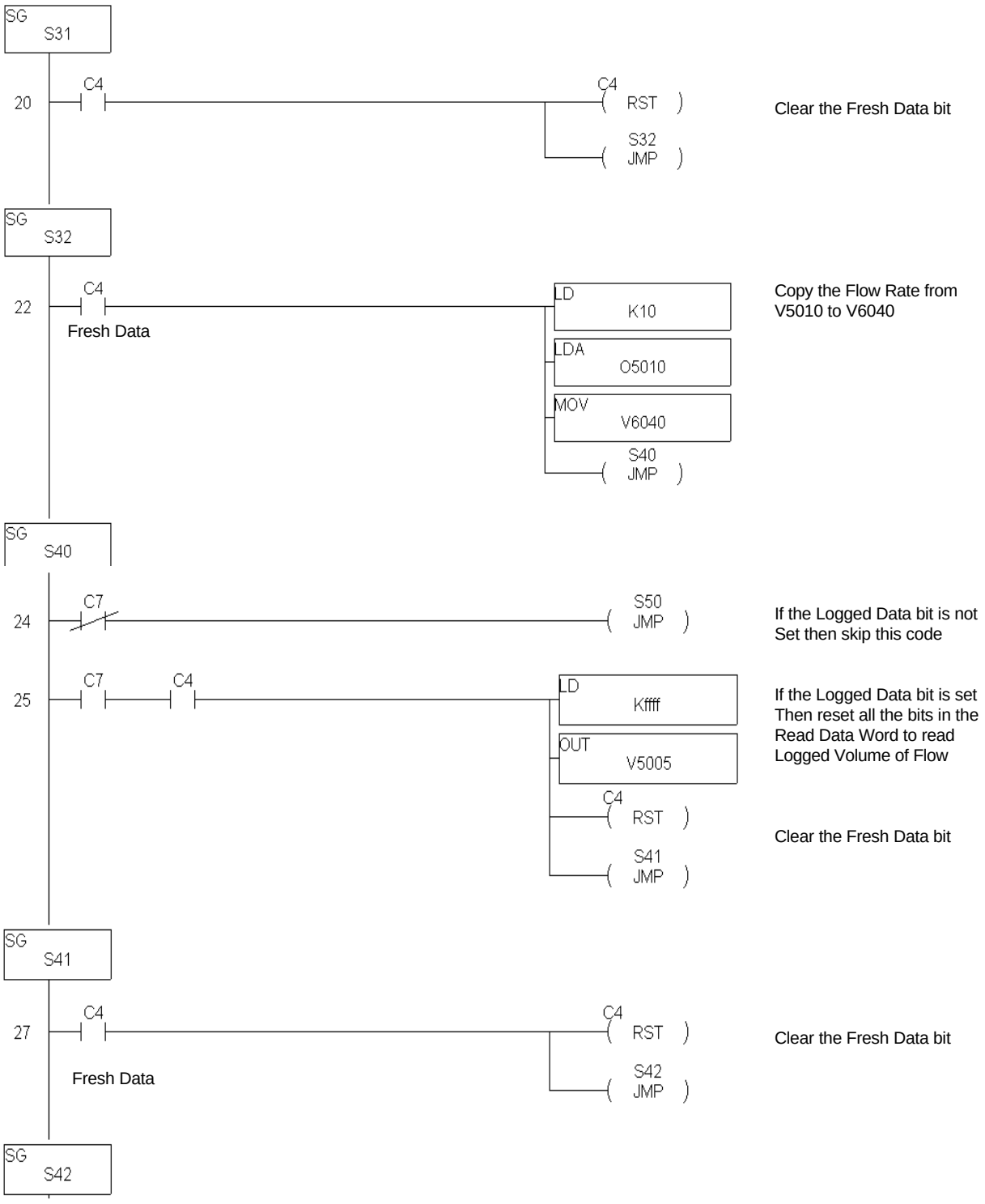
(2) Stages are activated by:
   a. Power flow transitions to a Stage.
   b. Jumping to a Stage.
   c. Setting the Stage status bit.
   d. The Initial Stage is activated at the start of RUN mode.

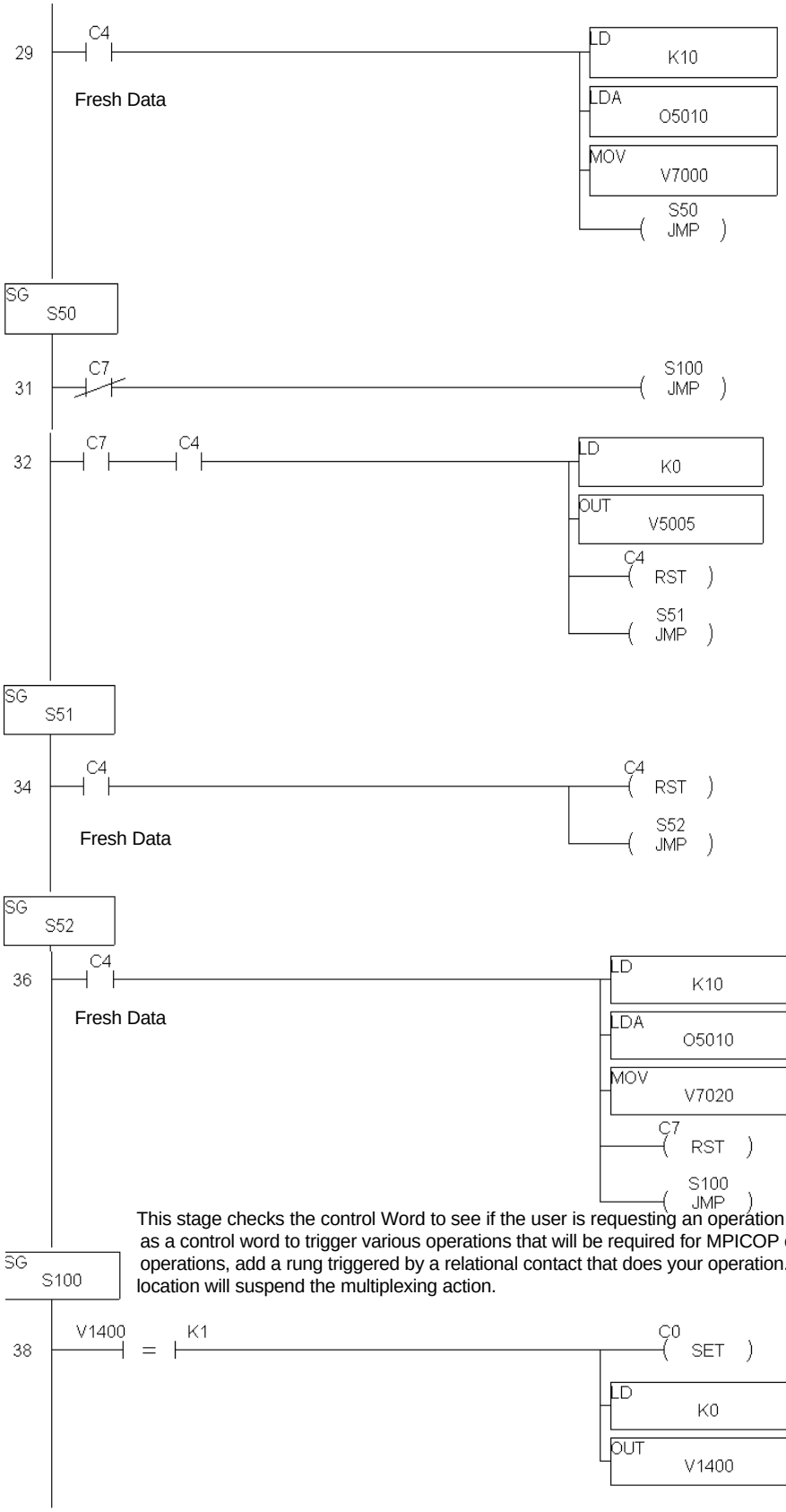
(3) Stages are deactivated by:
   a. Power flow transitions from a Stage.
   b. Jumping from a Stage.
   c. Resetting the Stage status bit.

MPICOP Multiplexing Ladder Logic




SG
S12
10
C4
Fresh Data
LD
K10
LDA
O5010
MOV
V6000
C10
RST
S20
JMP
Copy the Raw Count data
From V5010 to V6000
Clear the Fast PLC Update
Mode bit
SG
S20
16
C4
Fresh Data
LD
K10
LDA
O5010
MOV
V6020
S30
JMP
Copy the Indicated Volume of
Flow from V5010 to V6020
SG
S30
18
C4
Fresh Data
LD
Kff00
OUT
V5005
Data word
C4
RST
S31
JMP
Turn ON Read Flow Rate bits
For 8 channels in the Read
Clear the Fresh Data Bit


SG
S31
20
C4
C4
RST
S32
JMP
Clear the Fresh Data bit
SG
S32
22
C4
Fresh Data
LD
K10
LDA
O5010
MOV
V6040
S40
JMP
Copy the Flow Rate from
V5010 to V6040
SG
S40
24
C7
S50
JMP
If the Logged Data bit is not
Set then skip this code
25
C7
C4
LD
Kffff
OUT
V5005
C4
RST
S41
JMP
If the Logged Data bit is set
Then reset all the bits in the
Read Data Word to read
Logged Volume of Flow
Clear the Fresh Data bit
SG
S41
27
C4
C4
RST
S42
JMP
Fresh Data
Clear the Fresh Data bit
SG
S42



Copy the Logged Volume of Flow from V5010 to V7000

If the Logged Data bit is not set then skip this code

If the logged data bit is set Then set bits in Read Data Word to read Logged Flow Rate

Clear the Fresh Data bit

Clear the Fresh Data bit

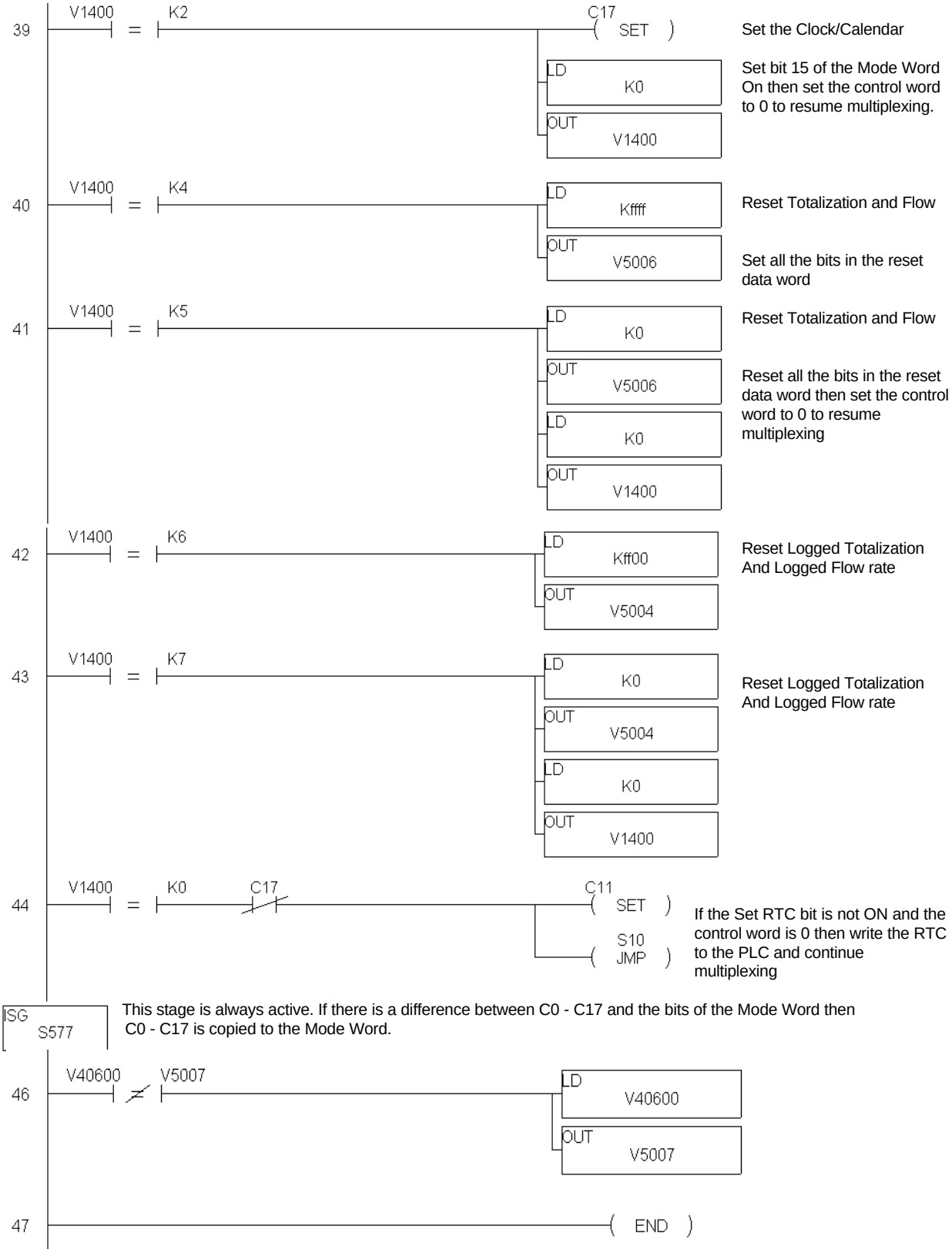
Copy the Logged Flow Rate from V5010 to V7020

Reset the Logged Data bit

This stage checks the control Word to see if the user is requesting an operation. V1400 is a location that is used as a control word to trigger various operations that will be required for MPICOP operation. To define your own operations, add a rung triggered by a relational contact that does your operation. A non-zero value in this location will suspend the multiplexing action.

Read configuration

Set bit 0 of the Mode Word On then set the control word to 0 to resume multiplexing


39
V1400
=
K2
C17
SET
LD
K0
OUT
V1400
Set the Clock/Calendar
Set bit 15 of the Mode Word On then set the control word to 0 to resume multiplexing.
40
V1400
=
K4
LD
Kffff
OUT
V5006
Reset Totalization and Flow
Set all the bits in the reset data word
41
V1400
=
K5
LD
K0
OUT
V5006
LD
K0
OUT
V1400
Reset Totalization and Flow
Reset all the bits in the reset data word then set the control word to 0 to resume multiplexing
42
V1400
=
K6
LD
Kff00
OUT
V5004
Reset Logged Totalization And Logged Flow rate
43
V1400
=
K7
LD
K0
OUT
V5004
LD
K0
OUT
V1400
Reset Logged Totalization And Logged Flow rate
44
V1400
=
K0
C17
C11
SET
S10
JMP
If the Set RTC bit is not ON and the control word is 0 then write the RTC to the PLC and continue multiplexing
ISG
S577
This stage is always active. If there is a difference between C0 - C17 and the bits of the Mode Word then C0 - C17 is copied to the Mode Word.
46
V40600
V5007
LD
V40600
OUT
V5007
47
END