Panasonic®

PROGRAMMABLE CONTROLLER

FP-M/FP1

APPLICATIONS

Technical Datasheet Vol. 1

Matsushita Electric Works, Ltd.

Safety Precautions

Observe the following notices to ensure personal safety or to prevent accidents.
To ensure that you use this product correctly, read this User's Manual thoroughly before use.
Make sure that you fully understand the product and information on safe.
This manual uses two safety flags to indicate different levels of danger.

WARNING

If critical situations that could lead to user's death or serious injury is assumed by mishandling of the product.

-Always take precautions to ensure the overall safety of your system, so that the whole system remains safe in the event of failure of this product or other external factor.
-Do not use this product in areas with inflammable gas. It could lead to an explosion.
-Exposing this product to excessive heat or open flames could cause damage to the lithium battery or other electronic parts.

CAUTION

If critical situations that could lead to user's injury or only property damage is assumed by mishandling of the product.

-To prevent abnormal exothermic heat or smoke generation, use this product at the values less than the maximum of the characteristics and performance that are assure in these specifications.
-Do not dismantle or remodel the product. It could lead to abnormal exothermic heat or smoke generation.
-Do not touch the terminal while turning on electricity. It could lead to an electric shock..
-Use the external devices to function the emergency stop and interlock circuit.
-Connect the wires or connectors securely.
The loose connection might cause abnormal exothermic heat or smoke generation
-Do not allow foreign matters such as liquid, flammable materials, metals to go into the inside of the product. It might cause exothermic heat or smoke generation.
-Do not undertake construction (such as connection and disconnection) while the power supply is on.

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CHAPTER 1

PULSE CATCH INPUT

Recognizing Short Width Input Signal

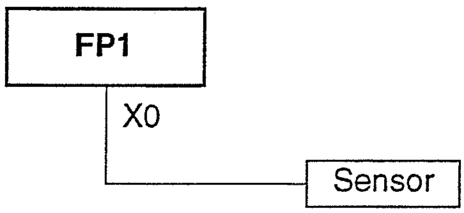
Availability
All FP-M and FP1

Outline

The pulse catch input function enables FP-M or FP1 to recognize the short input signal (0.5 ms or longer)

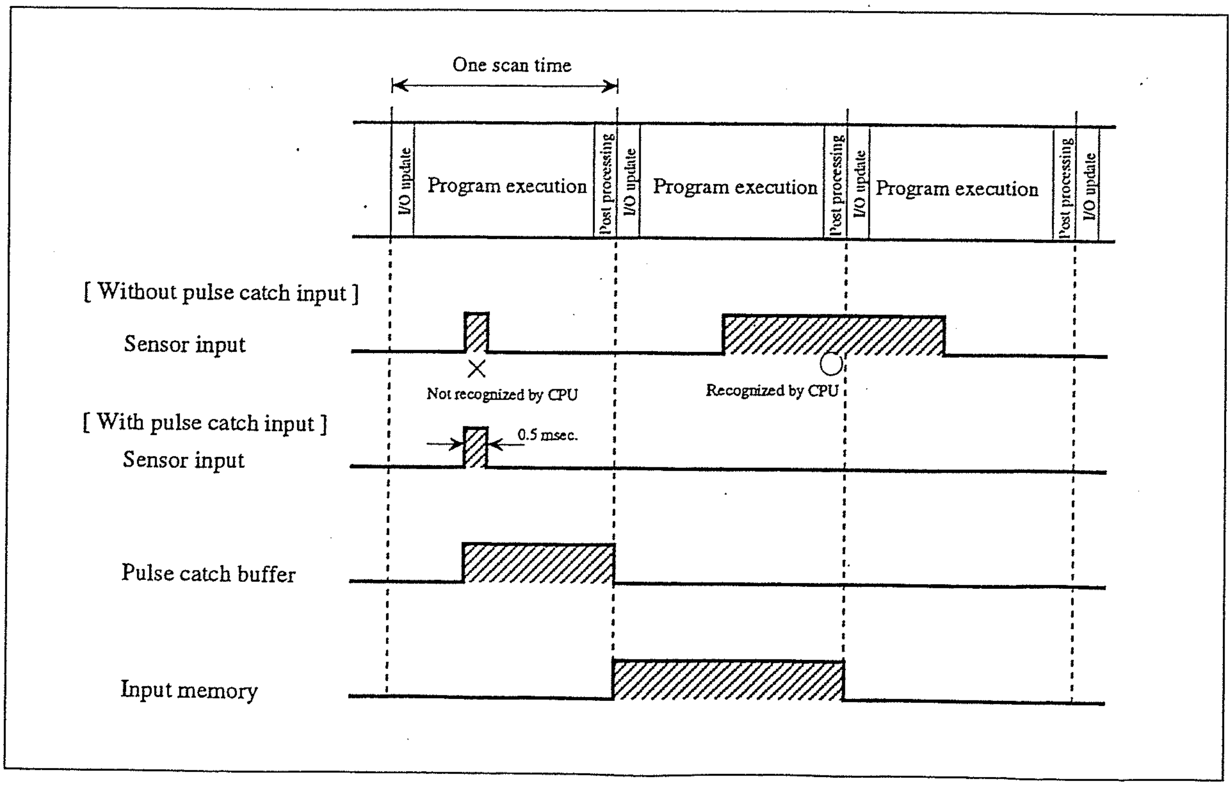
Configurations

- FP1 programmable controller
- Photoelectric sensor

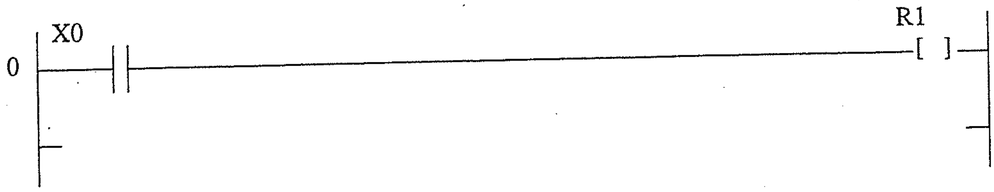


Explanation of example

If an input signal is longer than the scan time, the input signal can certainly be recognized by CPU. However, the duration of the scan time cannot be known because it depends on the kinds and number of instructions or the executed communications. The pulse catch input function of FP-M/FP1 detects the short input signal (ON) and memorizes its ON status in the pulse catch buffer. The memorized status is recognized by CPU at the time of proceeding I/O update.



Program example



Settings

- The settings for the pulse catch input function are performed by the system register 402 as follows:

  Input the specific value in an order so that the bit corresponding to each input becomes "1" when you use the pulse catch function.

  - System register 402

Bit position	15 • • 12	11 • • 8	7 • • 4	3 • • 0
Corresponding input	———	———	X7X6X5X4	X3X2X1X0

  - Setting range

  FP1 C14/C16 series (4 inputs X0 to X3) H0 to HF
  All FP-Ms and FP1
  C24/C40/C56/C72 series (8 inputs X0 to X7): H0 to HFF

  EXAMPLE:
  If the pulse catch function is used for inputs X3, X4 and X5 of the FP1 C24 series, input H38 as follows:

System register 402

Bit position	15 • • 12	11 • • 8	7 • • 4	3 • • 0
Corresponding input	———	———	X7X6X5X4	X3X2X1X0
Data input	0 0 0 0	0 0 0 0	0 0 1 1	1 0 0 0
		H	3	8

CHAPTER 2

INTERRUPT PROCESSING

High-speed I/O Transition

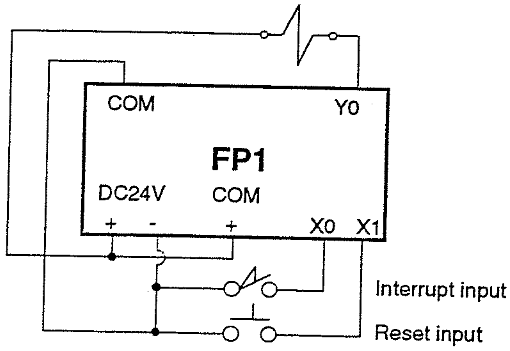
Availability
All FP-M and FP1 C24, C40, C56 and C72 series

Outline

The interrupt input function enables FP-M/FP1 to recognize short input signal (0.2 ms) and to execute the corresponding INT program suspending the currently executing process. Programming an F143 (IORF) instruction in the INT program makes it possible to update the output states without time-lag caused by the scan time.

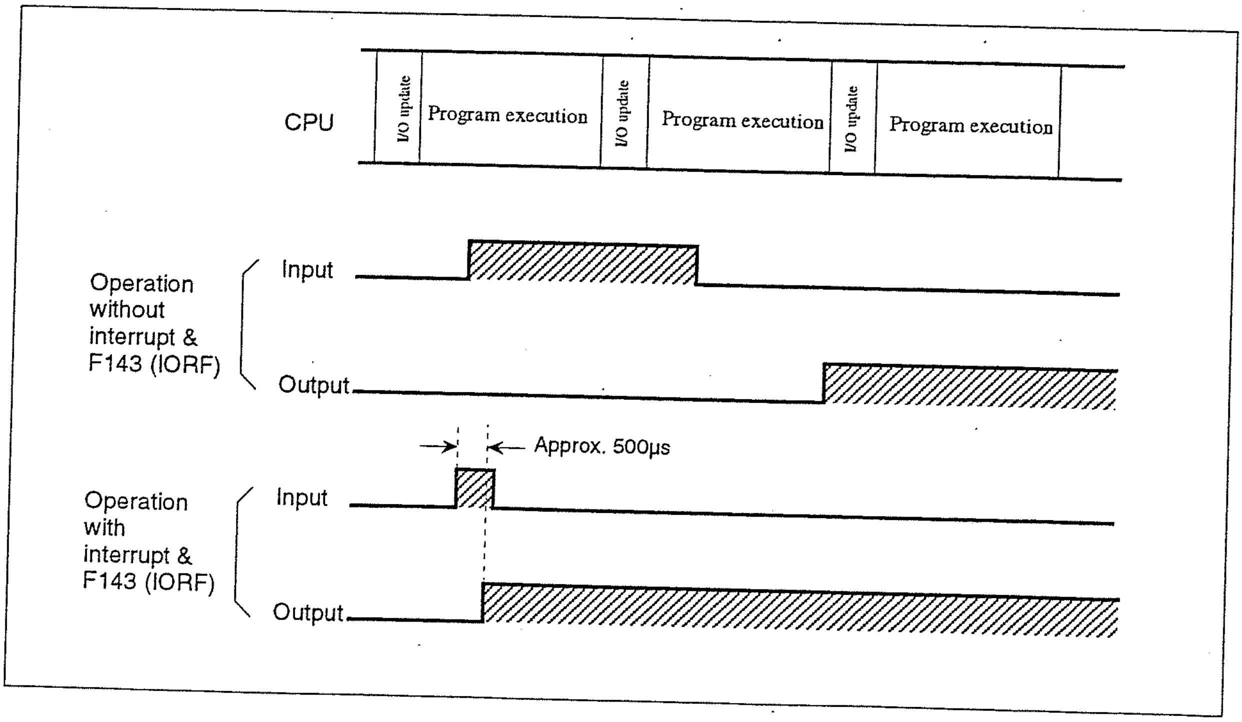
Configurations

- FP1 programmable controller

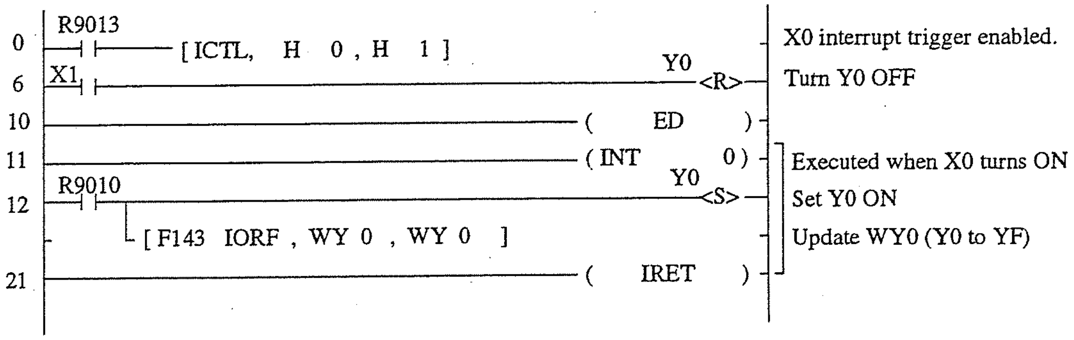


Explanation of example

When X0 turns ON, FP1 suspends the current executing process and executes INT0 program. Since the F143 (IORF) instruction is executed in the INT0 program, Y0 turns ON without waiting for I/O update stage. Y0 turns OFF when X1 turns ON.



Program example [File: SAMPL001]



Settings

- To use interrupt processing function, first, you need to set system register 403 as follows.

  The input mode setting of X0 through X7 can be changed using FP Programmer II or NPST-GR Software.

  Specifications of system register 403 are:

Bit position	15 • • 12	11 • • 8	7 • • 4	3 • • 0
Corresponding input	———	———	X7X6X5X4	X3X2X1X0

  0: not in interrupt mode
  1: in interrupt mode

  When the bit corresponding to each input is set to "1", the corresponding interrupt trigger becomes valid in the system of the programmable controller.

- Then execute ICTL instruction in the program to enable interrupt trigger X0.
  [ICTL, S1, S2]

  - How to specify S1
    S1 specified control functions and type of interrupts as follows:

  S1 specifications

Bit position	15 • • 12	11 • • 8	7 • • 4	3 • • 0
S1				

  S1 higher byte (bits 15 to 8): Selection of control function
  H00: Interrupt "enabled/disabled" control
  H01: Interrupt trigger "reset" control

  S1 lower byte (bits 7 to 0): Type selection of interrupt
  H00: Input-initiated interrupt (INT0 through INT7)
  H02: Time-initiated interrupt (INT24)

Type of interrupt	Data set in S1	Contents
Input-initiated interrupt (including high-speed counter-initiated interrupt)	H0	• When H0 is set in S1, enable/disable/conditions for all input-initiated interrupts (including high-speed counter-initiated interrupt) can be controlled. • The enable/disable settings for each interrupt trigger are specified by S2.
	H100	• When H100 is set in S1, interrupt triggers set to be executed can be cleared. • The selection of triggers to be cleared is specified by S2.
Time-initiated interrupt	H2	• When H2 is set in S1, time-initiated interrupt is specified. • Interrupt interval is specified by S2.

-, How to specify S2

S2 specifies the interrupt conditions according to data in S1 as follows:

① When H0 is set in S1:
S2 specifies enabled or disabled conditions for each input-initiated interrupt (including a high-speed counter-initiated interrupts).

S2 specifications [when S1 = H0]

Bit position	15 • • 12	11 • • 8	7 • • 4	3 • • 0
Corresponding INT number	———	———	7 6 5 4	3 2 1 0

0: disabled
1: enabled

When the bit corresponding to each INT number is set to "1", the corresponding interrupt trigger becomes effective.
Be sure to set system register 403 when you use an input-initiated interrupt.

Relationship between bit position and interrupt program

Bit position	Interrupt program	Interrupt trigger
0	INT0	X0 or high-speed counter
1	INT1	X1
2	INT2	X2
3	INT3	X3
4	INT4	X4
5	INT5	X5
6	INT6	X6
7	INT7	X7

② When H100 is set in S1:
S2 specifies input-initiated interrupt triggers whose existing condition should be cleared.

S2 specifications [when S1 = H100]

Bit position	15 • • 12	11 • • 8	7 • • 4	3 • • 0
Corresponding INT trigger	———	———	X7X6X5X4	X3X2X1X0

0: reset
1: remains effective

When the bit corresponding to each trigger is set to "0", the corresponding interrupt trigger expected for execution is cleared.
When a high-speed counter-initiated interrupt is used by INTO, if bit position 0 is set to "0", the trigger expected for execution is cleared as well.

Relationship between bit position and interrupt program

Bit position	Interrupt program	Interrupt trigger
0	INT0	X0 or high-speed counter
1	INT1	X1
2	INT2	X2
3	INT3	X3
4	INT4	X4
5	INT5	X5
6	INT6	X6
7	INT7	X7

③ When H2 is set in S1:
S2 specifies the interrupt interval for time-initiated interrupts.
The interval for time-initiated interrupts can be set as follows:
- S2 setting range: K0 to K3000
- The actual interval can be calculated using the formula: Interval (ms) = S2 × 10 (ms)

Table of S2 setting and interval

Data in S2	Interval
K0	Time-initiated interval not executed.
K1	10 ms interval
K2	20 ms interval
•	•
•	•
K100	1,000 ms (1 s) interval
•	•
•	•
K3000	30,000 ms (30 s) interval

Availability
Transistor output type FP-Ms and FP1 C24, C40, C56 and C72 series

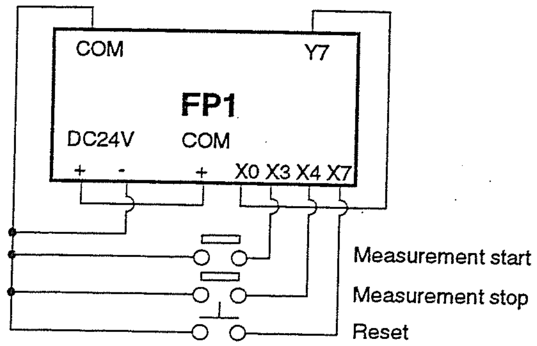
1 ms Units Timer

Outline

The duration of some event can be measured in units of 1 ms accuracy. Two interrupt triggers are used as start and stop triggers. The built-in high-speed counter is used as a timer combined with the pulse output function of the F164 (SPD0) instruction.

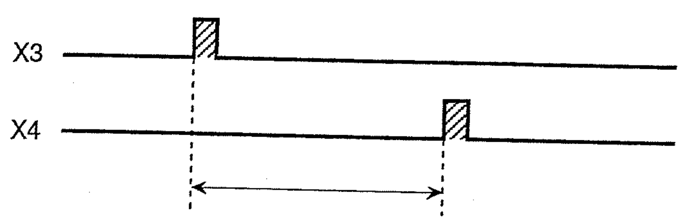
Configurations

- FP1 programmable controller



Explanation of example

- Y7 outputs pulses of approx. 1 k Hz (1004.9 Hz) to X0 (high-speed counter input) using the F164 (SPD0) instruction. When the time is not measured, the X0 ignores the pulses from the Y7. And when the X3 (start trigger) turns ON, the INT 3 program is executed and the high-speed counter starts counting pulses input to the X0. Then when the X4 (stop trigger) turns ON, the INT4 program is executed and the high-speed counter stop counting pulses input to the X0. If the X7 turns ON, the value of the high-speed counter in the DT9045 and DT9044 is cleared.



Time between pulses are:

$$\frac{1}{1\text{k Hz (1004.92 Hz)}} = 0.000995 \text{ s} = 0.995 \text{ ms.}$$

Time measured = (DT9045, DT9044) X 0.995 ms.

Program example [File: SAMPL002]

```
      R9013
0   --| |------[ICTL,  H  0 , H  18]                               X3 and X4 interrupt triggers enabled.
      R9013
6   --| |------[F0   MV   ,  K  0     ,  DT 0   ]                  Pulse mode set
               [F0   MV   ,  K  164   ,  DT 1   ]                  Approx 1k Hz set
               [F1   DMV  ,  K  8000000  ,  DT 2  ]                Tentative target of high-speed counter
               [F0   MV   ,  K  0     ,  DT 4   ]                  Pulse stops
      X7
29  --| |------(DF)----------------------------------> 1
    1 >--------[F0   MV   ,  H   2    ,  DT 9052]                  X0 count disabled
               [F1   DMV  ,  K     0  ,  DT 9044  ]                Counter reset
               [F164 SPD0 ,  DT   0 ]                              Pulse output starts
46  ------------------------------------------------(    ED     )
47  ------------------------------------------------( INT     3 )
      R9010
48  --| |------[F0   MV   ,  H   0    ,  DT 9052]                  X0 count enabled
54  ------------------------------------------------(   IRET    )
55  ------------------------------------------------( INT     4 )
      R9010
56  --| |------[F0   MV   ,  H   2    ,  DT 9052]                  X0 count disabled
62  ------------------------------------------------(   IRET    )
```

Settings

- To use built-in high-speed counter and the interrupt function, first you need to set system registers 400 and 403.
  - High-speed counter settings (system register 400)

H 0 □ 0 □

Setting

Set value	Input contact of FP-Ms and FP1s		
	X0	X1	X2
H0	High-speed counter function not used.		
H1	2-phase input		————
H2	2-phase input		Reset input
H3	Up input	————	
H4	Up input	————	Reset input
H5	————	Down input	————
H6	————	Down input	Reset input
H7	Up/Down input (X0: Up input, X1: Down input)		————
H8	Up/Down input (X0: Up input, X1: Down input)		Reset input

Setting
H0: Internally not connected
H1: Internally connected

Output pulse internal connection setting:
Available for transistor output type FP-Ms and FP1 C56 and C72 series

Set H3 (up input without reset in this case)
- Interrupt settings (system register 403)

The input mode setting of X0 through X7 can be changed using FP Programmer II or NPST-GR Software.

Specifications of system register 403 are:

Bit position	15 • • 12	11 • • 8	7 • • 4	3 • • 0
Corresponding input	———	———	X7X6X5X4	X3X2X1X0

0: not in interrupt mode
1: in interrupt mode

When the bit corresponding to each input is set to "1", the corresponding interrupt trigger becomes valid in the system of the programmable controller.

- To change the operation mode of the built-in high-speed counter, set the DT9052 using the F0 (MV) instruction as follows:

  [F0 MV , S , DT9052]

  S operations of the high-speed counter using bit positions 0 to 3.
  The setting range of S is: H0 to HF

Bit position	15 • • 12	11 • • 8	7 • • 4	3	2	1	0
S	———	———	———				

④ **High-speed counter related instruction control bit** (weight of this bit is 8)
0: The **F162 (HC0S)**, **F163 (HC0R)**, **F164 (SPD0)**, and **F165 (CAM0)** instructions continue to operate.
1: The **F162 (HC0S)**, **F163 (HC0R)**, **F164 (SPD0)**, and **F165 (CAM0)** instructions are cleared.

③ **Reset input X2 availability control bit** (weight of this bit is 4)
0: Reset input X2 enabled.
1: Reset input X2 disabled.

② **Count input control bit** (weight of this bit is 2)
0: Count inputs are accepted.
1: Count inputs are ignored.

① **Software reset control bit** (weight of this bit is 1)
0: Software reset operation is not performed.
1: Elapsed value of the high-speed counter is reset.

In the example,
- S = H2 for ignoring X0 input
- S = H0 for accepting X0 input

- To change the elapsed value of the built-in high-speed counter, set the DT9045 and DT9044 using the F1 (DMV) instruction as follows:

  [F1 DMV, S, DT9044]

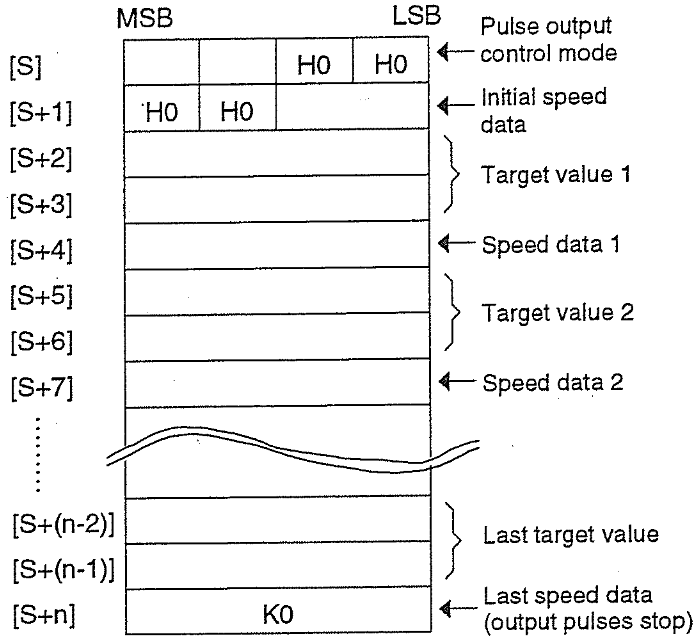
  $K\text{-}8{,}388{,}608 \leqq S \leqq K8{,}388{,}607$

In the example,
- S = K0 for timer reset

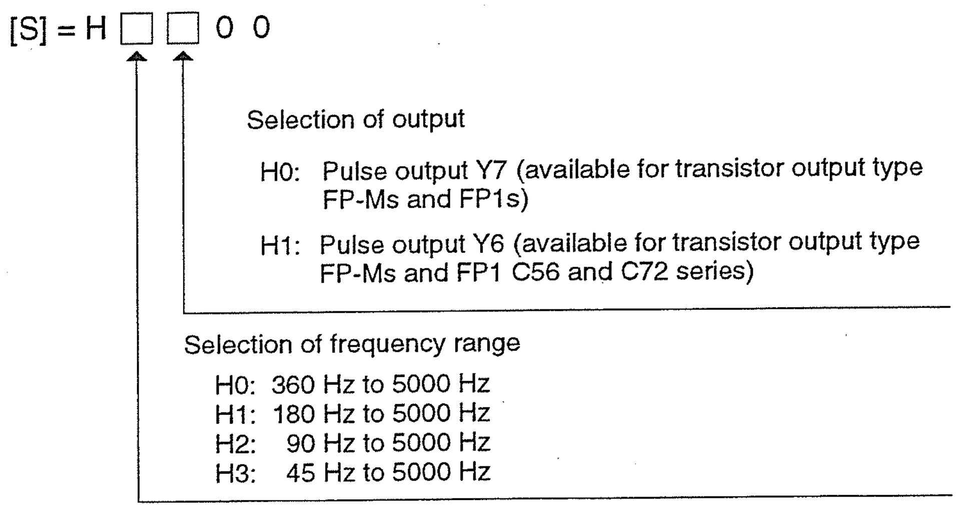
- To output pulses from the Y7, use the F164 (SPD0) instruction as follows:

  [F164 SPD0 , S]

S specifies the pulse output control mode, pulse output frequency and target value as follows:



① Pulse output control mode setting
Selects the frequency range and the outputs used for the instruction using hexadecimal data as follows:



② Speed data (output pulse frequency) setting
Use the speed data to specify the output pulse frequency for the pulse output.
Speed data specification range: K0 to K255
The speed data can be set using the following method

- The speed data can be set using a formula.
  When **frequency range 0** is selected: Speed data = 257 - 93458/setting frequency
  When **frequency range 1** is selected: Speed data = 257 - 46948/setting frequency
  When **frequency range 2** is selected: Speed data = 257 - 23419/setting frequency
  When **frequency range 3** is selected: Speed data = 257 - 11723/setting frequency

③ Target value setting
When the elapsed value on the high-speed counter matches the target value, the output switches to the specified frequency. The target value occupies 2 words (32-bit data).
Setting range: K-8,388,608 to K8,388,607

④ Pulse output stop
Set K0 at the final address of the control data to stop pulse output.

Adding Counters

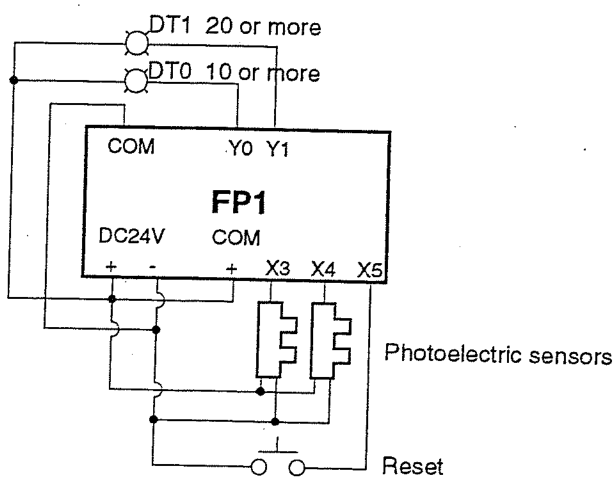
Availability
All FP-Ms and FP1 C24, C40, C56 and C72 series

Outline

When you use two or more high-speed counters, you can add a few counters with the speed of 500 Hz besides the built-in high-speed counter by using interrupt input functions.

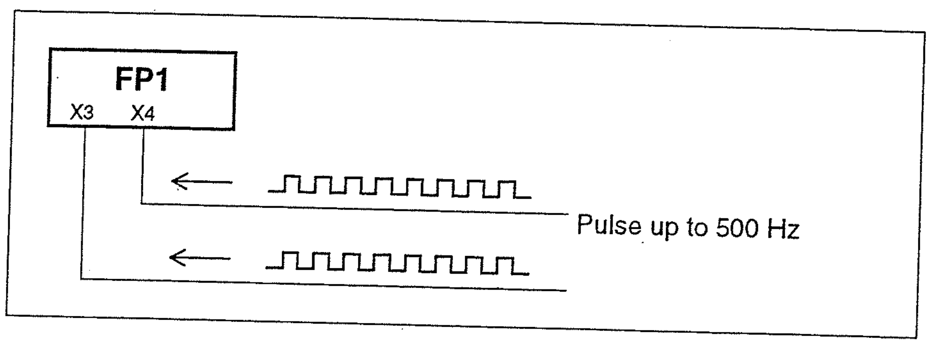
Configurations

- FP1 programmable controller
- Photoelectric sensor



Explanation of example

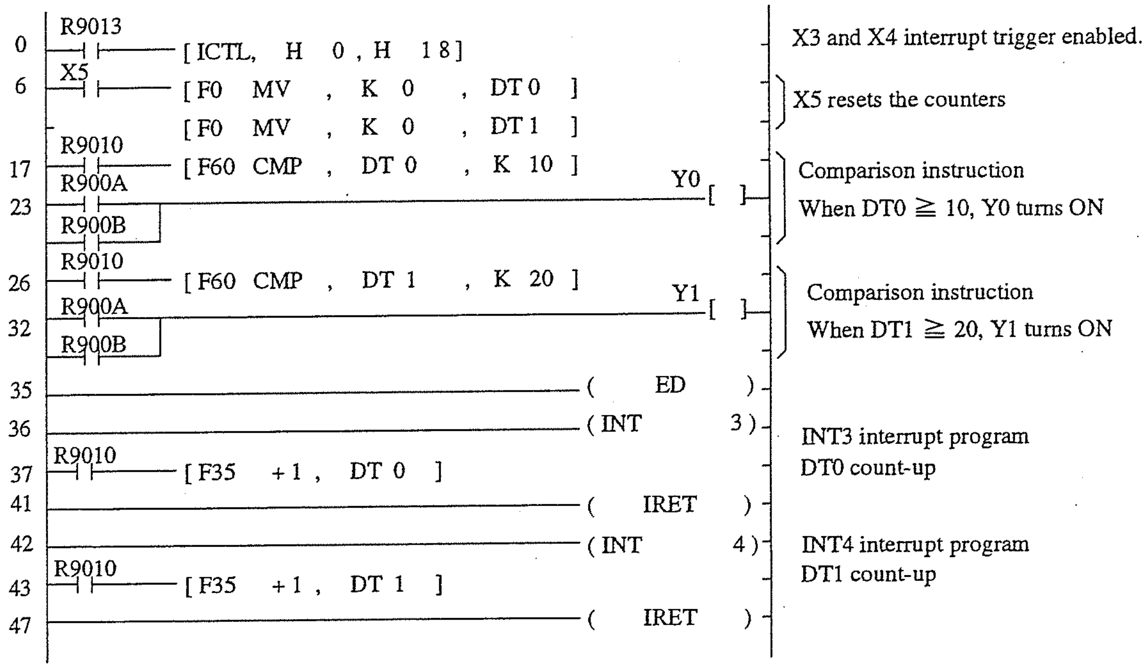
When X3 turns ON, the INT3 program is executed and the value in the DT0 is increased by 1.
When the value in the DT0 becomes 10, the Y0 turns ON.
When X4 turns ON, the INT4 program is executed and the value in the DT1 is increased by 1.
When the value in the DT1 becomes 20, the Y1 turns ON.



Note:

If there is possibility that pulses to X3 and X4 are input at the same time, the counting speed should be lowered down to 300 Hz.

Program example [File: SAMPL003]



Settings

- To use interrupt function, first you need to set system register 403 as follows:

  Input the specific value in an order so that the bit corresponding to each input becomes "1" when you use interrupt programs.

  System register 403

Bit position	15 • • 12	11 • • 8	7 • • 4	3 • • 0
Corresponding input	————	————	X7X6X5X4	X3X2X1X0

  In the example, H18 is set to the system register 403.

- Then, set the interrupt condition using the ICTL instruction
  [ICTL, S1, S2]

- How to specify S1
  S1 specifies control functions and type of interrupts as follows:

S1 specifications

Bit position	15 • • 12	11 • • 8	7 • • 4	3 • • 0
S1				

S1 higher byte — Selection of control function
H00: Interrupt "enabled/disabled" control
H01: Interrupt trigger "reset" control

S1 lower byte — Type selection of interrupt
H00: Input-initiated interrupt (INT0 through INT7)
H02: Time-initiated interrupt (INT24)

- How to specify S2

  S2 specifies the interrupt conditions according to data in S1 as follows:

① When H0 is set in S1:
S2 specifies enabled or disabled conditions for each input-initiated interrupt (including a high-speed counter-initiated interrupts).

S2 specifications [when S1 = H0]

Bit position	15 • • 12	11 • • 8	7 • • 4	3 • • 0	
Corresponding INT number	———	———	7 6 5 4	3 2 1 0	0: disabled 1: enabled

When the bit corresponding to each **INT** number is set to "1", the corresponding interrupt trigger becomes effective.

② When H100 is set in S1:
S2 specifies input-initiated interrupt triggers whose existing condition should be cleared.

S2 specifications [when S1 = H100]

Bit position	15 • • 12	11 • • 8	7 • • 4	3 • • 0	
Corresponding INT trigger	———	———	X7X6X5X4	X3X2X1X0	0: reset 1: remains effective

When the bit corresponding to each trigger is set to "0", the corresponding interrupt trigger expected for execution is cleared.

③ When H2 is set in S1:
S2 specifies the interrupt interval for time-initiated interrupts.
The interval for time-initiated interrupts can be set as follows:
- S2 setting range: K0 to K3000
- The actual interval can be calculated using the formula: Interval (ms) = S2 × 10 (ms)

Availability
Transistor output type FP-Ms and FP1 C24, C40, C56 and C72 series

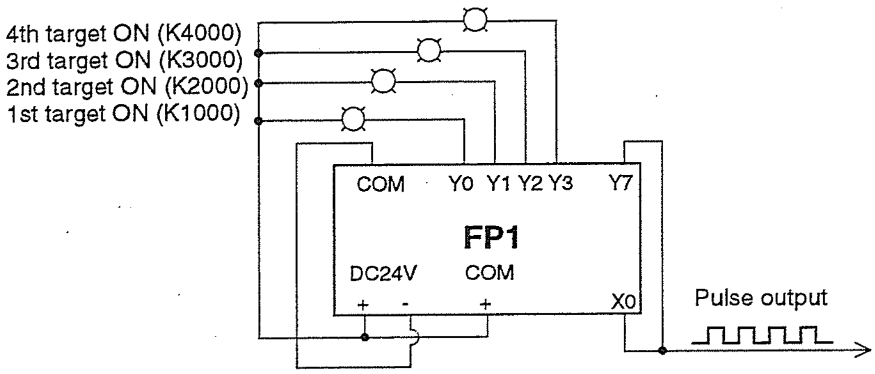
High-speed Counter Initiated Interrupt

Outline

The interrupt program INT0 is executed when the high-speed counter counts pulses upto the preset targets.
This function (high-speed counter initiated interrupt) enables FP-M/FP1 to execute a program without time-lag caused by the scan time when the elapsed value of the high-speed counter agrees with its target value.

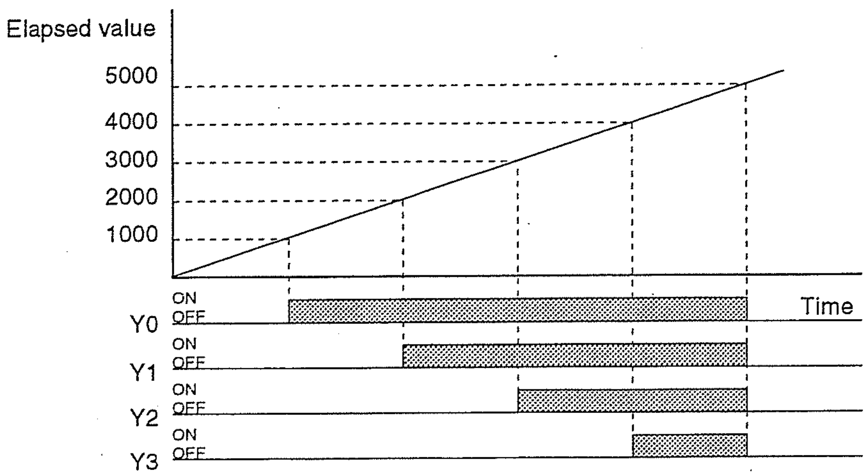
Configurations

- FP1 Programmable controller



Explanation of example

The INT0 program is used for the high-speed counter initiated interrupt. The INT0 is executed each time the elapsed value of the high-speed counter agrees with the target. In the example, Y0 turns ON when the value in the DT9045 and DT9044 becomes K1000, Y1 ON when it becomes K2000, Y2 ON when it becomes K3000, and Y4 ON when it becomes K4000.



Program example [File: SAMPL004]

Step	Contact	Instruction	Comment
0	R9013	[ICTL, H 0 , H 1]	X0 interrupt trigger enabled
6	R9013	[F0 MV , K 0 , DT 0]	Pulse output mode setting
		[F0 MV , K 238 , DT 1]	Initial speed data
		[F1 DMV , K 1000 , DT 2]	Target value 1
		[F0 MV , K 238 , DT 4]	Speed data 1
		[F1 DMV , K 2000 , DT 5]	Target value 2
		[F0 MV , K 238 , DT 7]	Speed data 2
		[F1 DMV , K 3000 , DT 8]	Target value 3
		[F0 MV , K 238 , DT 10]	Speed data 3
		[F1 DMV , K 4000 , DT 11]	Target value 4
		[F0 MV , K 238 , DT 13]	Speed data 4
		[F1 DMV , K 5000 , DT 14]	Last target value
		[F0 MV , K 0 , DT 16]	Pulse stops
77	R9013	[F0 MV , H 1 , DT 9052]	Pulse output start program
		[F0 MV , H 0 , DT 9052]	
		[F164 SPD0 , DT 0]	
91	R903A	(DF/) Y0 <R>, Y1 <R>, Y2 <R>, Y3 <R>	Output reset
105		(ED)	
106		(INT 0)	
107	R9010	[F1 DMV , DT 9044 , DT 100]	Transfer the elapsed value to DT101 & DT100
		[F60 CMP , DT 100 , K 1000]	
120	R900A / R900B	Y0 <S>	Comparison When DT100 ≧ 1000, Y0 turns ON
125	R9010	[F60 CMP , DT 100 , K 2000]	
131	R900A / R900B	Y1 <S>	Comparison When DT100 ≧ 2000, Y1 turns ON
136	R9010	[F60 CMP , DT 100 , K 3000]	
142	R900A / R900B	Y2 <S>	Comparison When DT100 ≧ 3000, Y2 turns ON
147	R9010	[F60 CMP , DT 100 , K 4000]	
153	R900A / R900B	Y3 <S>	Comparison When DT100 ≧ 4000, Y3 turns ON
158	R9010	[F143 IORF , WY 0 , WY 0]	Partial I/O update
164		(IRET)	

Settings

- To use the high-speed counter-initiated interrupt, first you need to set system register 400. (You do not have to set system register 403.)
  - High-speed counter settings (system register 400)

H 0 □0 □

Setting

Set value	Input contact of FP-Ms and FP1s		
	X0	X1	X2
H0	High-speed counter function not used.		
H1	2-phase input		————
H2	2-phase input		Reset input
H3	Up input	————————	
H4	Up input	————	Reset input
H5	————	Down input	————
H6	————	Down input	Reset input
H7	Up/Down input (X0: Up input, X1: Down input)		————
H8	Up/Down input (X0: Up input, X1: Down input)		Reset input

Setting
H0: Internally not connected
H1: Internally connected

Output pulse internal connection setting:
Available for transistor output type FP-Ms and FP1 C56 and C72 series

In the example, H3 is set to system register 400.

- To change the operation mode of the built-in high-speed counter, set the DT9052 using the F0 (MV) instruction as follows:

  [F0 MV , S , DT9052]

  S operations of the high-speed counter using bit positions 0 to 3.
  The setting range of S is: H0 to HF

Bit position	15 • • 12	11 • • 8	7 • • 4	3	2	1	0
S	———	———	———				

④ **High-speed counter related instruction control bit** (weight of this bit is 8)
- 0: The **F162 (HC0S)**, **F163 (HC0R)**, **F164 (SPD0)**, and **F165 (CAM0)** instructions continue to operate.
- 1: The **F162 (HC0S)**, **F163 (HC0R)**, **F164 (SPD0)**, and **F165 (CAM0)** instructions are cleared.

③ **Reset input X2 availability control bit** (weight of this bit is 4)
- 0: Reset input X2 enabled.
- 1: Reset input X2 disabled.

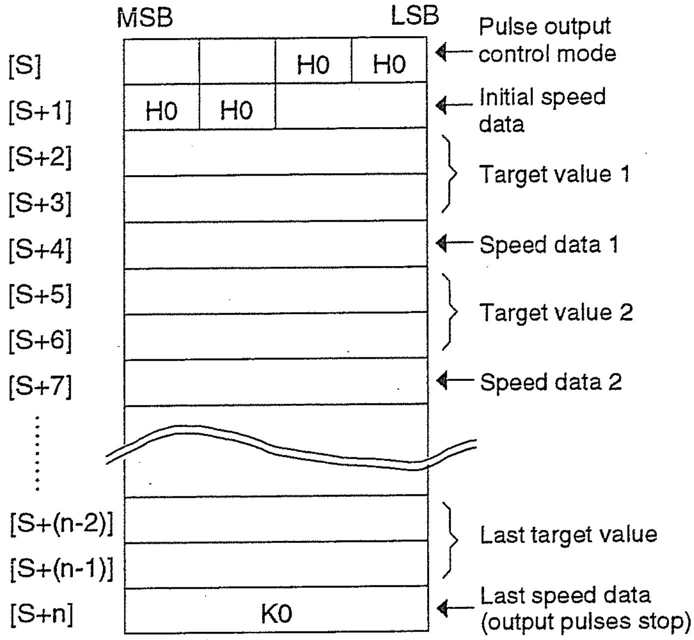
② **Count input control bit** (weight of this bit is 2)
- 0: Count inputs are accepted.
- 1: Count inputs are ignored.

① **Software reset control bit** (weight of this bit is 1)
- 0: Software reset operation is not performed.
- 1: Elapsed value of the high-speed counter is reset.

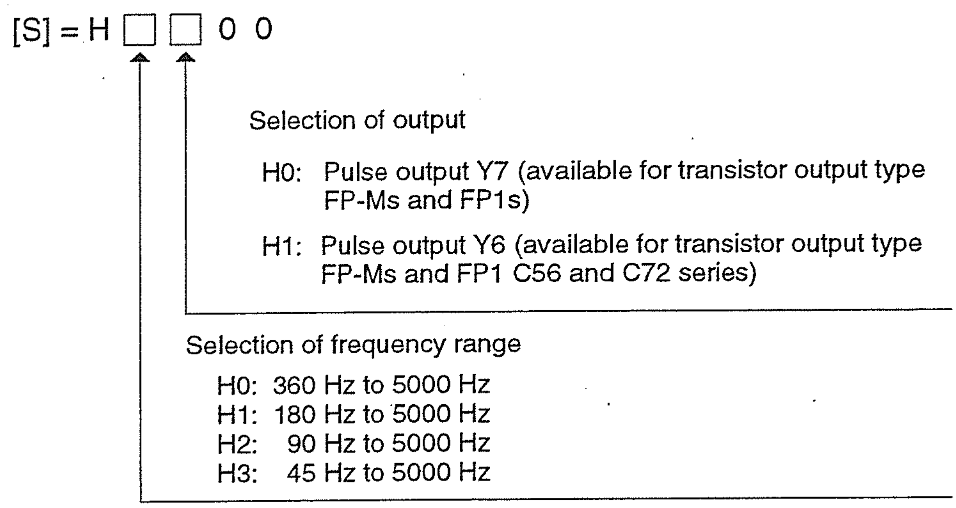
In the example,
- S = H1 for clearing the elapsed value of the high-speed counter
- S = H0 for setting the X0 in the pulse acceptable mode

- To output pulses from the Y7, use the F164 (SPD0) instruction as follows:
  [F164 SPD0 , S]

S specifies the pulse output control mode, pulse output frequency and target value as follows:



① Pulse output control mode setting
Selects the frequency range and the outputs used for the instruction using hexadecimal data as follows:



② Speed data (output pulse frequency) setting
Use the speed data to specify the output pulse frequency for the pulse output.
Speed data specification range: K0 to K255
The speed data can be set using the following method

- The speed data can be set using a formula.
  When **frequency range 0** is selected: Speed data = 257 - 93458/setting frequency
  When **frequency range 1** is selected: Speed data = 257 - 46948/setting frequency
  When **frequency range 2** is selected: Speed data = 257 - 23419/setting frequency
  When **frequency range 3** is selected: Speed data = 257 - 11723/setting frequency

③ Target value setting
When the elapsed value on the high-speed counter matches the target value, the output switches to the specified frequency. The target value occupies 2 words (32-bit data).
Setting range: K-8,388,608 to K8,388,607

④ Pulse output stop
Set K0 at the final address of the control data to stop pulse output.

Calculating RPM for Drum Rotation

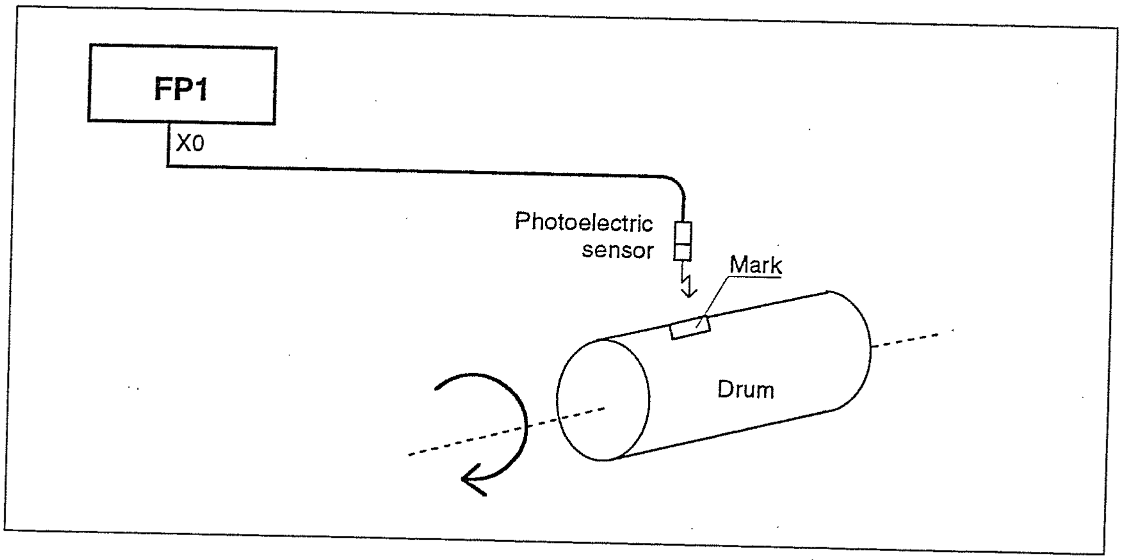
Availability
All FP-M and FP1 C24, C40, C56 and C72 series

Outline

The interrupt input functions enable FP-M/FP1 to count the rotation of the drum and calculate the rpm (rotations per minute).

Configurations

- FP1 programmable controller
- Photoelectric sensor



Explanation of example

Each time X0 detects the mark on the rotating drum (minimum ON time = 200 μs, minimum OFF time = 200 μs), the INT0 program is executed and DT0 is increased by 1. The time-initiated interrupt program INT24 calculates the rpm by multiplying 60 and the value in the DT0 then clear the DT0 value in 1s interval.

Program example [File: SAMPL005]

```
0   R9013
    --| |----[ICTL,  H  0 , H   1 ]              X0 interrupt enabled.
             [ICTL,  H  2 , K  100 ]             1s unit time-initiated interrupt
11  X7
    --| |----[F0  MV  , K  0   , DT0  ]          Data reset by X7 ON
             [F0  MV  , K  0   , DT1  ]
22  -------------------------------( ED   )
23  -------------------------------( INT  0 )
24  R9010
    --| |----[F35  +1 ,  DT 0  ]                 Increase DT0 by 1
                                                 when X0 turns ON
28  -------------------------------( IRET  )
29  -------------------------------( INT  24 )
30  R9010
    --| |----[F35  *  ,  DT 0  ,  K 60 ,  DT1 ]  Calculating rpm in 1s interval
             [F0  MV  , K  0   , DT0  ]          Clear DT0 after calculation
43  -------------------------------( IRET  )
```

Settings

- To use input-initiated interrupt, first you need to set system register 403. For using the time initiated interrupt, you do not need to set system register.
  - Input initiated interrupt settings (system register 403).

  The input mode setting of X0 through X7 can be changed using FP Programmer II or NPST-GR Software.

  Specifications of system register 403 are:

Bit position	15 • • 12	11 • • 8	7 • • 4	3 • • 0
Corresponding input	———	———	X7X6X5X4	X3X2X1X0

0: not in interrupt mode
1: in interrupt mode

When the bit corresponding to each input is set to "1", the corresponding interrupt trigger becomes valid in the system of the programmable controller.

In the example, H1 is set to the system register 403.

- To control interruption, you need to perform settings using the ICTL instruction as follows:

  [ICTL, S1, S2]

- How to specify S1

  S1 specifies control functions and type of interrupts as follows:

S1 specifications

Bit position	15 • • 12	11 • • 8	7 • • 4	3 • • 0
S1				

S1 higher byte (bits 15–8): Selection of control function
- H00: Interrupt "enabled/disabled" control
- H01: Interrupt trigger "reset" control

S1 lower byte (bits 7–0): Type selection of interrupt
- H00: Input-initiated interrupt (INT0 through INT7)
- H02: Time-initiated interrupt (INT24)

Type of interrupt	Data set in S1	Contents
Input-initiated interrupt (including high-speed counter-initiated interrupt)	H0	• When H0 is set in S1, enable/disable/conditions for all input-initiated interrupts (including high-speed counter-initiated interrupt) can be controlled. • The enable/disable settings for each interrupt trigger are specified by S2.
	H100	• When H100 is set in S1, interrupt triggers set to be executed can be cleared. • The selection of triggers to be cleared is specified by S2.
Time-initiated interrupt	H2	• When H2 is set in S1, time-initiated interrupt is specified. • Interrupt interval is specified by S2.

- How to specify S2

S2 specifies the interrupt conditions according to data in S1 as follows:

① When H0 is set in S1:
S2 specifies enabled or disabled conditions for each input-initiated interrupt (including a high-speed counter-initiated interrupts).

S2 specifications [when S1 = H0]

Bit position	15 • • 12	11 • • 8	7 • • 4	3 • • 0
Corresponding INT number	———	———	7 6 5 4	3 2 1 0

0: disabled
1: enabled

When the bit corresponding to each **INT** number is set to "1", the corresponding interrupt trigger becomes effective.
Be sure to set system register 403 when you use an input-initiated interrupt.

Relationship between bit position and interrupt program

Bit position	Interrupt program	Interrupt trigger
0	INT0	X0 or high-speed counter
1	INT1	X1
2	INT2	X2
3	INT3	X3
4	INT4	X4
5	INT5	X5
6	INT6	X6
7	INT7	X7

② When H100 is set in S1:
S2 specifies input-initiated interrupt triggers whose existing condition should be cleared.

S2 specifications [when S1 = H100]

Bit position	15 • • 12	11 • • 8	7 • • 4	3 • • 0
Corresponding INT trigger	———	———	X7X6X5X4	X3X2X1X0

0: reset
1: remains effective

When the bit corresponding to each trigger is set to "0", the corresponding interrupt trigger expected for execution is cleared.
When a high-speed counter-initiated interrupt is used by **INT0**, if bit position 0 is set to "0", the trigger expected for execution is cleared as well.

Relationship between bit position and interrupt program

Bit position	Interrupt program	Interrupt trigger
0	INT0	X0 or high-speed counter
1	INT1	X1
2	INT2	X2
3	INT3	X3
4	INT4	X4
5	INT5	X5
6	INT6	X6
7	INT7	X7

③ When H2 is set in S1:
S2 specifies the interrupt interval for time-initiated interrupts.
The interval for time-initiated interrupts can be set as follows:
- S2 setting range: K0 to K3000
- The actual interval can be calculated using the formula: Interval (ms) = S2 × 10 (ms)

Table of S2 setting and interval

Data in S2	Interval
K0	Time-initiated interval not executed.
K1	10 ms interval
K2	20 ms interval
•	•
•	•
K100	1,000 ms (1 s) interval
•	•
•	•
K3000	30,000 ms (30 s) interval

Analog Output Using Pulse Width Modulation Function

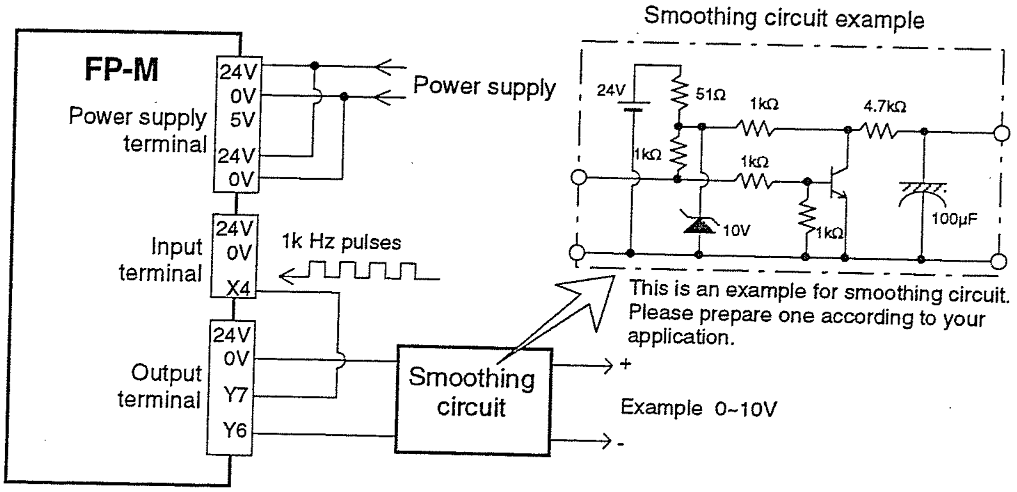
Availability
Transistor output type FP-Ms and FP1 C24, C40, C56 and C72 series

Outline

The interrupt input high-speed counter and F164 (SPD0) instruction enable FP-M/FP1 to output analog signals through a smoothing circuit.

Configurations

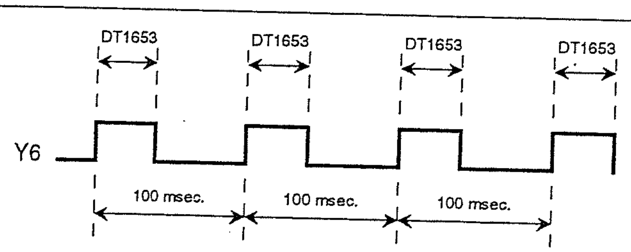
- FP-M programmable controller
- Smoothing circuit



Note:
It is recommended to make a smoothing circuit with large impedance so that the analog output-voltage will not be influenced by that of field device.

Explanation of example

- FP-M outputs pulses with the frequency of 1k Hz from the Y7 using the F164 (SPD0) instruction. Each time the pulses from the Y7 is input to the X4, the INT4 program is executed. In the INT4 program, the number of pulses is stored in the DT1654 increasing one each time the INT4 program is executed. The value in the DT1654 is compared with the value in the DT1653 and K100 also in the INT4 program. When DT1654 $<$ DT1653, Y6 turns ON and when DT1653 $\leqq$ DT1654 $\leqq$ K100, Y6 turns OFF.
By changing the value in the DT1653 (duty ratio), you can set analog output value.



* K0 is set to DT1654 when DT1654 becomes larger than K100.

Program example [File: SAMPL006]

```
 0  R9013                                                       1k Hz pulse output preparation
    ─┤ ├──────[ F0   MV   ,  K  0        , DT 1654 ]            Set K0 to DT1654
              [ F1   DMV  ,  K- 8000000  , DT 9044 ]            High-speed counter elapsed value set
              [ F0   MV   ,  K  0        , DT 1655 ]            Mode setting
              [ F0   MV   ,  K  164      , DT 1656 ]            1k Hz setting
              [ F1   DMV  ,  K  8000000  , DT 1657 ]            Tentative target value
              [ F0   MV   ,  K  0        , DT 1659 ]            Pulse output stops
              [ ICTL,  H  0 , H  10 ]                           X4 interrupt enabled
              [ F164 SPD0 ,  DT 1655 ]                          Pulse output start
43  ──────────────────────────────────────────( ED     )
44  ──────────────────────────────────────────( INT  4 )        INT4 program
45  R9010                                                       16-bit data band compare
    ─┤ ├──────[ F62  WIN  , DT 1654 , DT 1653 , K 100 ]
53  R900C                                           Y6
    ─┤ ├──────────────────────────────────────[     ]           When DT1654 < DT1654, Y6 turns ON
55  R900A
    ─┤ ├──────[ F0   MV   ,  K  0    , DT 1654 ]                When 100 < DT1654, DT1654 is set to 0
61  R9010
    ─┤ ├──────[ F143 IORF ,  WY 0    , WY 0    ]                Partial I/O update
              [ F35  +1   ,  DT 1654 ]                          DT1654 increment
72  ──────────────────────────────────────────( IRET   )
```

Settings

- To use the pulse output and interrupt function, first you need to set system registers 400 and 403 as follows:
  - High-speed counter settings to use the pulse output (system register 400).

H 0 □ 0 □

Setting

Set value	Input contact of FP-Ms and FP1s		
	X0	X1	X2
H0	High-speed counter function not used.		
H1	2-phase input		――
H2	2-phase input		Reset input
H3	Up input	――	
H4	Up input	――	Reset input
H5	――	Down input	――
H6	――	Down input	Reset input
H7	Up/Down input (X0: Up input, X1: Down input)		――
H8	Up/Down input (X0: Up input, X1: Down input)		Reset input

Setting
H0: Internally not connected
H1: Internally connected

In the example, H3 is set in the system register 403.

- Interrupt input settings (system register 403)

The input mode setting of X0 through X7 can be changed using FP Programmer II or NPST-GR Software.

Specifications of system register 403 are:

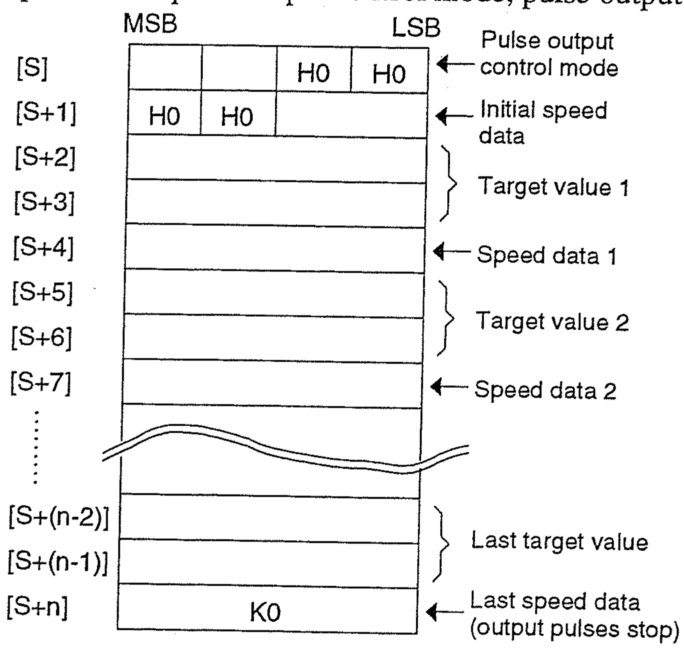
Bit position	15 • • 12	11 • • 8	7 • • 4	3 • • 0
Corresponding input	———	———	X7X6X5X4	X3X2X1X0

0: not in interrupt mode
1: in interrupt mode

When the bit corresponding to each input is set to "1", the corresponding interrupt trigger becomes valid in the system of the programmable controller.

- Then, perform the F164 (SPD0) instruction settings as follows:
  [F164 SPD0 , S]

.S specifies the pulse output control mode, pulse output frequency and target value as follows:



① Pulse output control mode setting
Selects the frequency range and the outputs used for the instruction using hexadecimal data as follows:

[S] = H □ □ 0 0

Selection of output

H0: Pulse output Y7 (available for transistor output type FP-Ms and FP1s)

H1: Pulse output Y6 (available for transistor output type FP-Ms and FP1 C56 and C72 series)

Selection of frequency range

H0: 360 Hz to 5000 Hz
H1: 180 Hz to 5000 Hz
H2: 90 Hz to 5000 Hz
H3: 45 Hz to 5000 Hz

② Speed data (output pulse frequency) setting
Use the speed data to specify the output pulse frequency for the pulse output.
Speed data specification range: K0 to K255
The speed data can be set using the following method

- The speed data can be set using a formula.
  When **frequency range 0** is selected: Speed data = 257 - 93458/setting frequency
  When **frequency range 1** is selected: Speed data = 257 - 46948/setting frequency
  When **frequency range 2** is selected: Speed data = 257 - 23419/setting frequency
  When **frequency range 3** is selected: Speed data = 257 - 11723/setting frequency

③ Target value setting
When the elapsed value on the high-speed counter matches the target value, the output switches to the specified frequency. The target value occupies 2 words (32-bit data).
Setting range: K-8,388,608 to K8,388,607

④ Pulse output stop
Set K0 at the final address of the control data to stop pulse output.

- And last, set the operation for interrupt using the ICTL instruction.

  [ICTL, S1, S2]

- How to specify S1
  S1 specifies control functions and type of interrupts as follows:

S1 specifications

Bit position	15 • • 12	11 • • 8	7 • • 4	3 • • 0
S1				

S1 higher byte (bits 15 to 8): Selection of control function
- H00: Interrupt "enabled/disabled" control
- H01: Interrupt trigger "reset" control

S1 lower byte (bits 7 to 0): Type selection of interrupt
- H00: Input-initiated interrupt (INT0 through INT7)
- H02: Time-initiated interrupt (INT24)

Type of interrupt	Data set in S1	Contents
Input-initiated interrupt (including high-speed counter-initiated interrupt)	H0	• When H0 is set in S1, enable/disable/conditions for all input-initiated interrupts (including high-speed counter-initiated interrupt) can be controlled. • The enable/disable settings for each interrupt trigger are specified by S2.
	H100	• When H100 is set in S1, interrupt triggers set to be executed can be cleared. • The selection of triggers to be cleared is specified by S2.
Time-initiated interrupt	H2	• When H2 is set in S1, time-initiated interrupt is specified. • Interrupt interval is specified by S2.

- How to specify S2

S2 specifies the interrupt conditions according to data in S1 as follows:

① When H0 is set in S1:
S2 specifies enabled or disabled conditions for each input-initiated interrupt (including a high-speed counter-initiated interrupts).

S2 specifications [when S1 = H0]

Bit position	15 • • 12	11 • • 8	7 • • 4	3 • • 0
Corresponding INT number	———	———	7 6 5 4	3 2 1 0

0: disabled
1: enabled

When the bit corresponding to each **INT** number is set to "1", the corresponding interrupt trigger becomes effective.
Be sure to set system register 403 when you use an input-initiated interrupt.

Relationship between bit position and interrupt program

Bit position	Interrupt program	Interrupt trigger
0	INT0	X0 or high-speed counter
1	INT1	X1
2	INT2	X2
3	INT3	X3
4	INT4	X4
5	INT5	X5
6	INT6	X6
7	INT7	X7

② When H100 is set in S1:
S2 specifies input-initiated interrupt triggers whose existing condition should be cleared.

S2 specifications [when S1 = H100]

Bit position	15 • • 12	11 • • 8	7 • • 4	3 • • 0
Corresponding INT trigger	———	———	X7X6X5X4	X3X2X1X0

0: reset
1: remains effective

When the bit corresponding to each trigger is set to "0", the corresponding interrupt trigger expected for execution is cleared.
When a high-speed counter-initiated interrupt is used by **INT0**, if bit position 0 is set to "0", the trigger expected for execution is cleared as well.

Relationship between bit position and interrupt program

Bit position	Interrupt program	Interrupt trigger
0	INT0	X0 or high-speed counter
1	INT1	X1
2	INT2	X2
3	INT3	X3
4	INT4	X4
5	INT5	X5
6	INT6	X6
7	INT7	X7

③ When H2 is set in S1:
S2 specifies the interrupt interval for time-initiated interrupts.
The interval for time-initiated interrupts can be set as follows:
- S2 setting range: K0 to K3000
- The actual interval can be calculated using the formula: Interval (ms) = S2 × 10 (ms)

Table of S2 setting and interval

Data in S2	Interval
K0	Time-initiated interval not executed.
K1	10 ms interval
K2	20 ms interval
•	•
•	•
K100	1,000 ms (1 s) interval
•	•
•	•
K3000	30,000 ms (30 s) interval

CHAPTER 3

POTENTIOMETER FUNCTION

Availability
All FP-Ms and FP1

Changing Timer Set Value

Outline

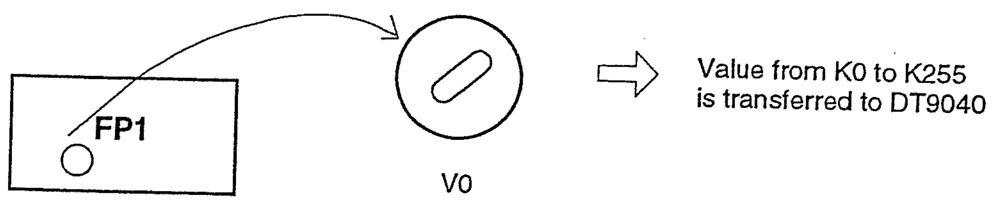
The potentiometers and their dial-set registers enable FP-M/FP1 to change the timer set value with a slotted-screw driver.

Potentiometers and their dial-set register

Dial-set register	Potentiometer	FP-1			FP-M
		C14 C16	C24	C40 C56 C72	
DT9040	V0	A	A	A	A
DT9041	V1	N/A	A	A	A
DT9042	V2	N/A	N/A	A	N/A
DT9043	V3	N/A	N/A	A	N/A

Configurations

- FP1 programmable controller



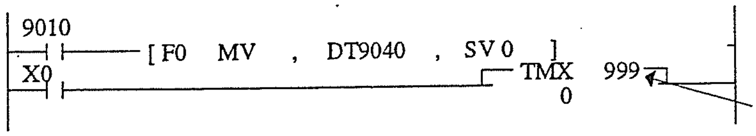
Explanation of example

When the potentiometer V0 of the FP1 is rotated, the value in the DT9040 is revised in the range of 0 to 255. By transferring the value in the DT9040 into the SV0 (the set value for TM0 instruction), you can change the timer set value.

Program examples

1. Basic [File: SAMPL007]

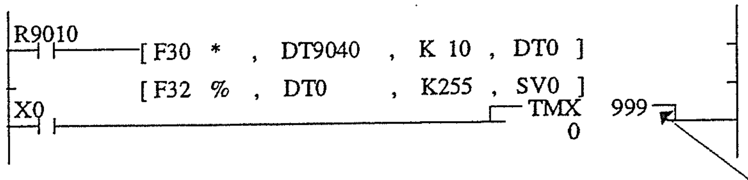
This transfers the value adjusted by the potentiometer V0



Transfers value in the DT9040 to SV0

Timer set value "999" here is only a tentative one.

2. High-level [File: SAMPL008]



Multiplying 10 with the value in the DT9040 and stores the result in DT0

Dividing DT0 by 255 and set the result to SV0.

You can change the value in the SV0 in the range of 0 to 10.

Timer set value "999" here is only a tentative one.

CHAPTER 4

ANALOG INPUT PROCESSING

Availability
All FP-Ms and FP1

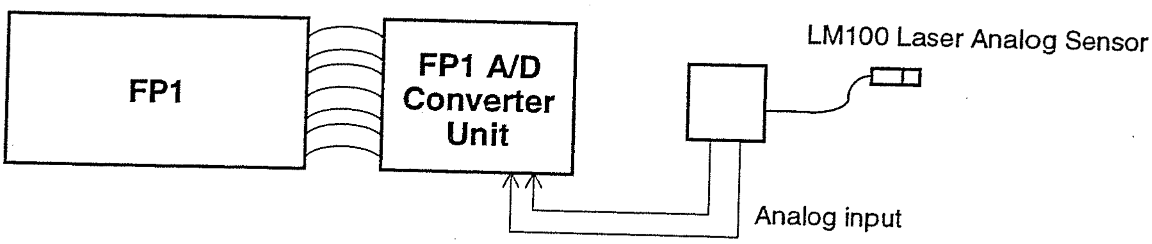
Averaging Analog Input Data

Outline

FP-M/FP1 averages data input through A/D converter (FP-M: board, FP1: unit) using a program.

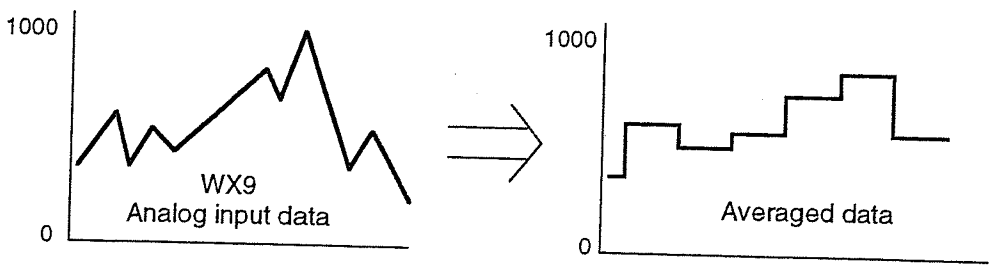
Configurations

- FP1 programmable controller
- FP1 A/D converter unit
- LM100 laser analog sensor



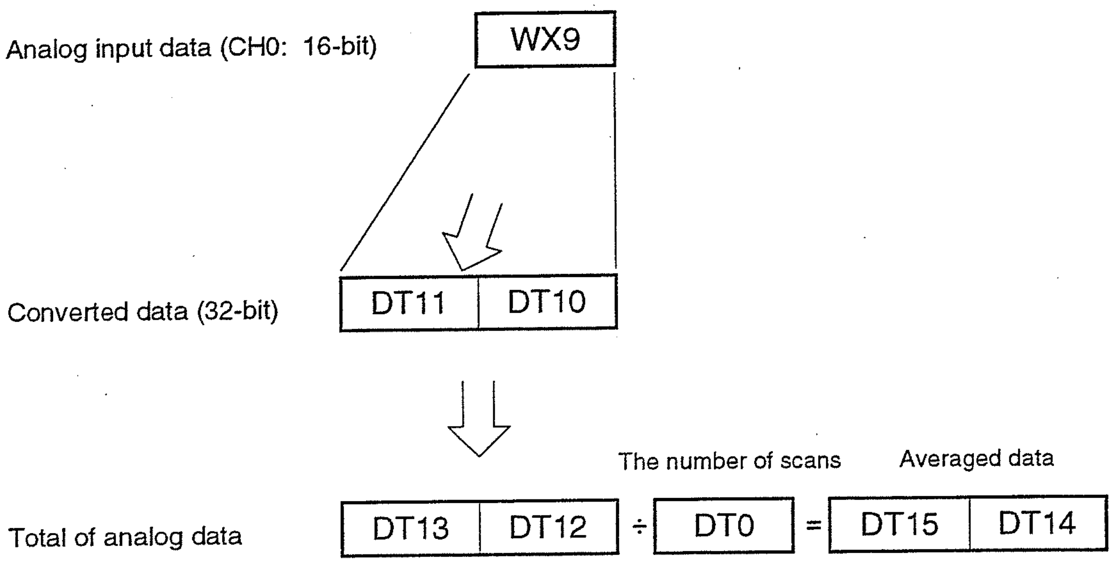
Explanation of example

Analog input data can be averaged by adding 100 continuous analog data from WX9 and then dividing the result by 100. Since the analog data is updated once a scan, the number of input data can be counted by counting the number of scans.



Program example [File: SAMPL009]

```
                                                  Times of sampling
    R9010
0  ─┤ ├──── [ F35,  +1   ,  DT 0        ]                          ┐ Counting times of scans
            [ F60,  CMP  ,  DT 0   ,  K 100   ]                    ┘
    R900A                                               R0
9  ─┤ ├─────────────────────────────────────────────────[ ] ──      Turns ON once per 100 scans
    R9010
11 ─┤ ├──── [ F0    MV   ,  WX 9   ,  DT 10   ]                    ┐ Converting input data to 32-bit
            [ F89   EXT  ,  DT 10     ]                            ┘
            [ F21   D+   ,  DT 10  ,  DT 12   ]                      Adding converted data
    R0
27 ─┤ ├──── [ F33   D%   ,  DT 12  ,  DT 0   ,  DT14  ]              Averaging
            [ F0    MV   ,  K 0    ,  DT 0    ]                      Clear the counted scan times
            [ F1    DMV  ,  K          0 ,   DT 12  ]                Clear the data
```



Averaging Analog Input Data with Disregarding Abnormal Value

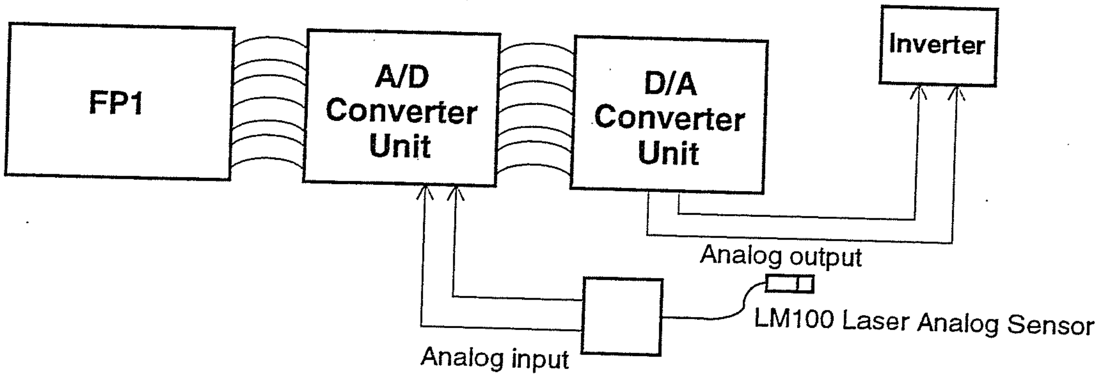
Availability
All FP-Ms and FP1

Outline

FP-M/FP1 averages data input through A/D converter (FP-M: board, FP1: unit) with disregarding abnormal data. In the example program, besides the upper/lower limits specified, sudden changes in the analog data can also be ignored.

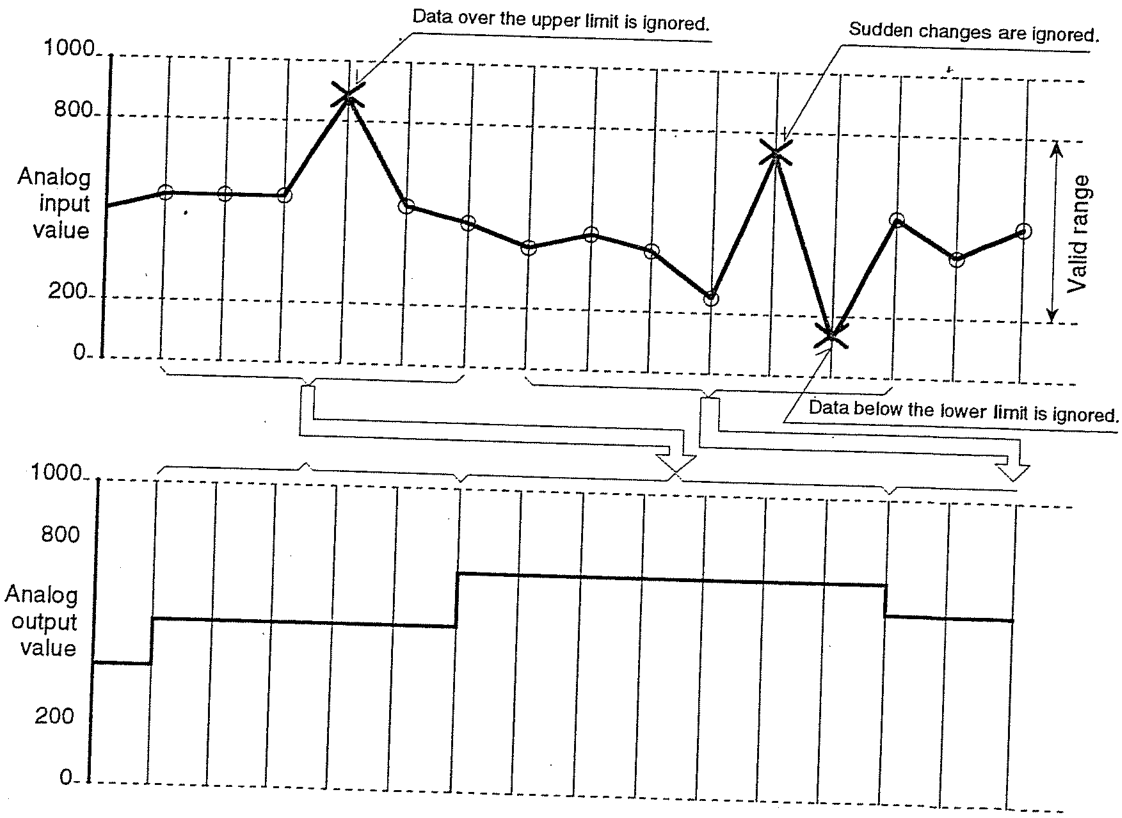
Configurations

- FP1 programmable controller
- FP1 A/D converter unit
- LM100 laser analog sensor
- FP1 D/A converter unit
- Inverter (variable motor drive)



Explanation of example

The data exceeding upper or lower limits and sudden changes in the analog data are ignored. Then the data regarded as normal are averaged and FP1 outputs analog data through the D/A Converter Unit.



Program example [File: SAMPL010]

```
      R9013
0    --| |------[F0   MV   , K 0    , IX    ]                          ① Initialize IX and IY
                [F0   MV   , K 0    , IY    ]
      R9010
11   --| |------[F0   MV   , DT 0   , SV 0  ]                          ② Sampling interval setting
      T0                                        TMR  999
17   --|/|--------------------------------------[        ]
                                                  0
      T0                                            R0
21   --| |------(DF/)--+----------------------------[ ]                ③ Sampling start
      R0               |
     --| |-------------+
      R0     T0                                     R1
25   --| |---| |------------------------------------[ ]                ④ Sampling trigger
      R1
28   --| |------[F60  CMP  , WX 9   , DT 1  ]                          ⑤ Lower limit detection
      R1     R900C                                  R2
34   --| |---| |------------------------------------[ ]
      R1
37   --| |------[F60  CMP  , DT 2   , WX 9  ]                          ⑤ Upper limit detection
      R1     R900C                                  R3
43   --| |---| |------------------------------------[ ]
      R2                                            R4
46   --| |---+--------------------------------------[ ]                Limit over
      R3     |
     --| |---+
      R9010
49   --| |------[F30  *    , DT 0   , K 10  , DT5  ]                   Sudden changes detection
                [F30  *    , DT 5   , DT 3  , DT7  ]
                [F33  D%   , DT 7   , K 50  , DT9  ]
      R1
75   --| |------[F27  -    , WX 9   , DT 11 , DT13 ]
                [F87  ABS  , DT 13  ]
                [F60  CMP  , DT 13  , DT 9  ]
      R1     R900A                                  R5
91   --| |---| |------------------------------------[ ]                ⑥ Disregarding sudden change
      R1     R4      R5                             R10
94   --| |---|/|-----|/|----------------------------[ ]                Data recognision
      R10
98   --| |------[F0   MV   , WX 9   , IXDT 20 ]                        ⑦ Storing data
                [F35  +1   , IX     ]
                [F60  CMP  , IX     , DT 4  ]
      R1     R4      R5      R900B                  R6
112  --| |---|/|-----|/|-----| |--------------------[ ]                Complete to store
      R6
117  --| |------------------------------------(MC     0)               ⑧ Averaging
      R6
120  --| |------[F0   MV   , K 0    , IX    ]
                [F0   MV   , K 1    , IY    ]
                [F27  -    , DT 4   , K 1   , DT13 ]
138  -------------------------------------------(LBL    0)             Label
      R6
139  --| |------[F22  +    , IXDT 20 , IYDT 20 , IYDT 20 ]             Repeat operation until DT13 = 0
                [F0   MV   , IYDT 20 , DT 15 ]
                [F35  +1   , IX     ]
                [F35  +1   , IY     ]
                [LOOP 0    , DT 13  ]                                  Loop
      R6
162  --| |------[F32  %    , DT 15  , DT 4  , DT 15 ]                  Average value calculation
                [F0   MV   , K 0    , IX    ]                          Initialize IX and IY
                [F0   MV   , K 0    , IY    ]
180  -------------------------------------------(MCE    0)             Averaging completed
      R6
182  --| |------[F0   MV   , DT 15  , WY 9  ]                          ⑨ Analog output
      T0
188  --| |------[F0   MV   , WX 9   , DT 11 ]                          ⑩ Memorizing reference analog input data
194  -------------------------------------------(  ED    )
```

DT0: Sampling interval. DT0 X 10 (ms) [recommended: 50 ms]
DT1: Lower limit (0 to 1000)
DT2: Upper limit (0 to 1000)
DT3: Allowable changes in 50 ms (1 to 1000)
DT4: Averaging times (1 to 30) [recommended: 5 times]

① Initial settings (IX and IY)
Index registers IX and IY are cleared at the first scan.

② Sampling interval (DT0)
Sampling interval for analog input data is specified by transferring the value in the DT0 to the SV0 of the TM0 instruction.

③ Sampling start (R0)
Sampling operations are started after the first sampling interval is elapsed.

④ Sampling trigger (R1)
Sampling trigger R1 turns ON in the specified sampling interval

⑤ Cutting analog input data exceeding upper (DT2) and lower (DT1) limits.
When analog input data exceeds upper (DT2) and lower (DT1) limits, R4 turns ON and the input data is ignored.

⑥ Cutting sudden changes in the data (R5)
Comparing the allowable analog data changes (DT9) with the actual changes (DT13), abnormality is detected. When abnormal change is detected, R5 turns ON and the input data is ignored.

DT0 X 10 = DT5 (ms) [Actual sampling interval]
DT5 X DT3 [Allowable changes in 50 ms] = DT7 [Allowable changes in 50 X DT5 (ms)]
DT7 ÷ K50 = DT9 [Allowable changes between samples]

⑦ Storing recognized data (DT20 ~)
Passed data is stored starting from DT20. The shift operation is performed adding 1 to the IX until IX equals to the value in the DT4 (sampling times).

⑧ Averaging data (DT15)
Once the sampled data reaches preset value, the averaging operation is performed using LOOP and F32 (%) instructions.

⑨ Output analog data (WY9)
By transferring the data in DT15 to WY9 (D/A) CH0 of unit No. 1), the averaged analog data is output through the D/A Converter Unit.

⑩ Memorizing reference analog input data (DT11)
By transferring the data in WX9 to DT11, the latest analog input data is memorized for checking sudden changes.

CHAPTER 5

BCD DISPLAY

Displaying 4-digit Decimal Number on the BCD Indicator

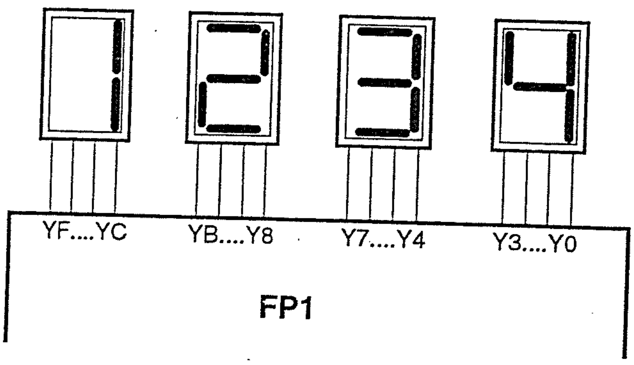
Availability
All FP-Ms and FP1

Outline

FP-M/FP1 displays 4-digit decimal numbers from 0 to 9999 on the BCD indicator

Configurations

- FP1 programmable controller
- 4-digit BCD indicator



Explanation of example

When X0 turns ON, K1111 is displayed on the BCD indicator. When X1 turns ON, K2222 is displayed. And when X2 turns ON, K3333 is displayed.

Program examples

Example 1. [File: SAMPL011]

```
      X0
 0  --| |------[ F0   MV   ,  K   1111  ,  DT 0   ]    Transfers K1111 to DT0
      X1
 6  --| |------[ F0   MV   ,  K   2222  ,  DT 0   ]    Transfers K2222 to DT0
      X2
12  --| |------[ F0   MV   ,  K   3333  ,  DT 0   ]    Transfers K3333 to DT0
      R9010
18  --| |------[ F80  BCD  ,  DT 0      ,  WY 0   ]    Converts the value in the
                                                       DT0 to BCD and output to
24  ------------------------------------( ED )         Y0 to YF
```

Example 2. [File: SAMPL012]

```
      X0
 0  --| |------[ F80  BCD  ,  K   1111  ,  WY 0   ]    Converts 1111 to BCD
      X1                                               and output to Y0 to YF
 6  --| |------[ F80  BCD  ,  K   2222  ,  WY 0   ]    Converts 2222 to BCD and
      X2                                               utput to Y0 to YF
12  --| |------[ F80  BCD  ,  K   3333  ,  WY 0   ]    Converts 3333 to BCD and
18  ------------------------------------( ED )         utput to Y0 to YF
```

Displaying 2-digit Decimal Number on the BCD Indicator

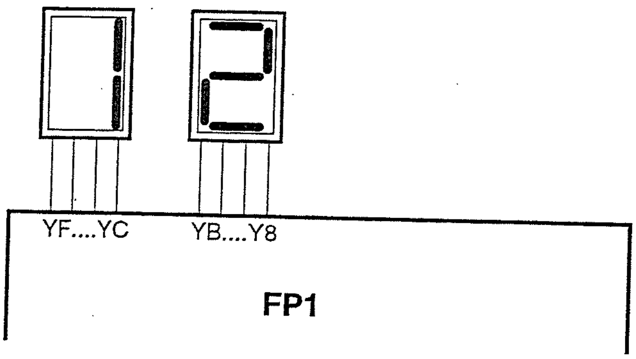
Availability
All FP-Ms and FP1

Outline

FP-M/FP1 displays 2-digit decimal numbers from 0 to 99 on BCD indicator. Using this displaying method, you can freely select output group in 4-bit units.

Configurations

- FP1 programmable controller
- 2-digit BCD indicator



Explanation of example

When X0 turns ON, K11 is displayed on the BCD indicator. When X1 turns ON, K22 is displayed. And when X2 turns ON, K33 is displayed.

(You can also shift outputs for BCD indicator to the range of Y0~ Y7 or Y4 to YB by changing the operand specified in F6 (DGT) instruction.)

Program examples

Example 1. [File: SAMPL013]

```
     X0
0  --| |------[F0  MV  , K  11 , DT 0  ]            Transfers K11 to DT0
     X1
6  --| |------[F0  MV  , K  22 , DT 0  ]            Transfers K22 to DT0
     X2
12 --| |------[F0  MV  , K  33 , DT 0  ]            Transfers K33 to DT0
     R9010
18 --| |------[F80 BCD , DT 0  , DT 1  ]            Converts the data in DT0 to
                                                      BCD and stores it to DT1.
              [F6  DGT , DT 1  , H  210 , WY 0 ]    Transfers data in DT1 to
31 ------------------------------------( ED )        Y8~YF
```

Example 2. [File: SAMPL014]

```
     X0
0  --| |------[F80 BCD , K  11 , DT 0  ]            Converts K11 to BCD and
                                                     stores it in DT0
     X1
6  --| |------[F80 BCD , K  22 , DT 0  ]            Converts K22 to BCD and
                                                     stores it in DT0
     X2
12 --| |------[F80 BCD , K  33 , DT 0  ]            Converts K33 to BCD and
                                                     stores it in DT0
     R9010
18 --| |------[F6  DGT , DT 0  , H 210 , WY 0 ]     Transfers data in DT0 to
26 ------------------------------------( ED )        Y8~YF
```

CHAPTER 6

DYNAMIC INPUT

Availability
Transistor output type FP-Ms and FP1 C24, C47, C56 and C72 series

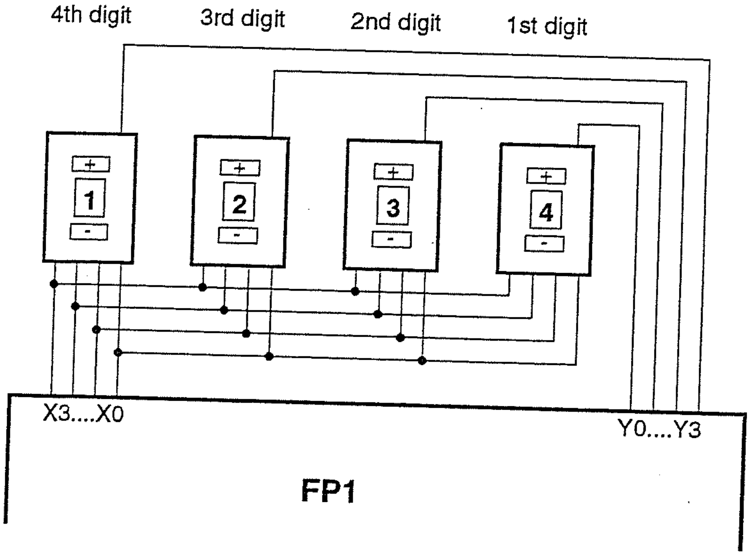
4-digit Digital Switch Input

Outline

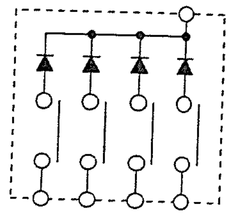
Data of the 4 digital switches, which usually requires 16 inputs, can be taken in to FP-M/FP1 only with 4 inputs and 4 outputs.

Configurations (NPN type example)

- FP1 programmable controller
- 4 digital-switches *



*Use digital switches with diodes to prevent influences from other digital switches



Explanation of example

- By cyclicly shifting the ON output relay from Y0 to Y3, FP1 selects one from 4 digital switches to be recognized at the following I/O update.
  The data taken to the FP1 are stored in the DT0 to DT3.
  WY0 is updated on the way of the scan by the F143 (IORF) instruction.

Program example

Example 1. [File: SAMPL015]

Initial OFF relay

```
0   R9014
    ─┤ ├──── [ F92  ENCO, WR 0 , H 2 ,  IX     ]   Encodes 4 bits of WR0
                                                    and stores the result in IX
             [ F6   DGT , WX 0 , H 0 , IXDT 0  ]   Transfers data in
                                                    hexadecimal digit position 0
             [ F101 SHL , WR 0 , K 1           ]   of WX0 to DT0~DT3.
                                                    Shits ON bit of WR0 to the left
20  R9013                                  R0
    ─┤ ├──┬─────────────────────────────[ ]─       When R4 turns ON, R0 goes ON
    R4    │                                         again
    ─┤ ├──┘
23  R0                                     Y0
    ─┤ ├────────────────────────────────[ ]─       1st digit
25  R1                                     Y1
    ─┤ ├────────────────────────────────[ ]─       2nd digit
27  R2                                     Y2
    ─┤ ├────────────────────────────────[ ]─       3rd digit
29  R3                                     Y3
    ─┤ ├────────────────────────────────[ ]─       4th digit
31  R9010
    ─┤ ├──── [ F143 IORF , WY 0 , WY 0 ]           Update WY0
```

Note:

- In order to gain time for I/O transition
  - place the program above at smaller address of all the program
  - add following program below the above program if you do not need any other program

```
R9010
─┤ ├──── [ F11 COPY , K 0 , DT 100 , DT500 ]
```

Availability
Transistor output type FP-Ms and FP1 C24, C47, C56 and C72 series

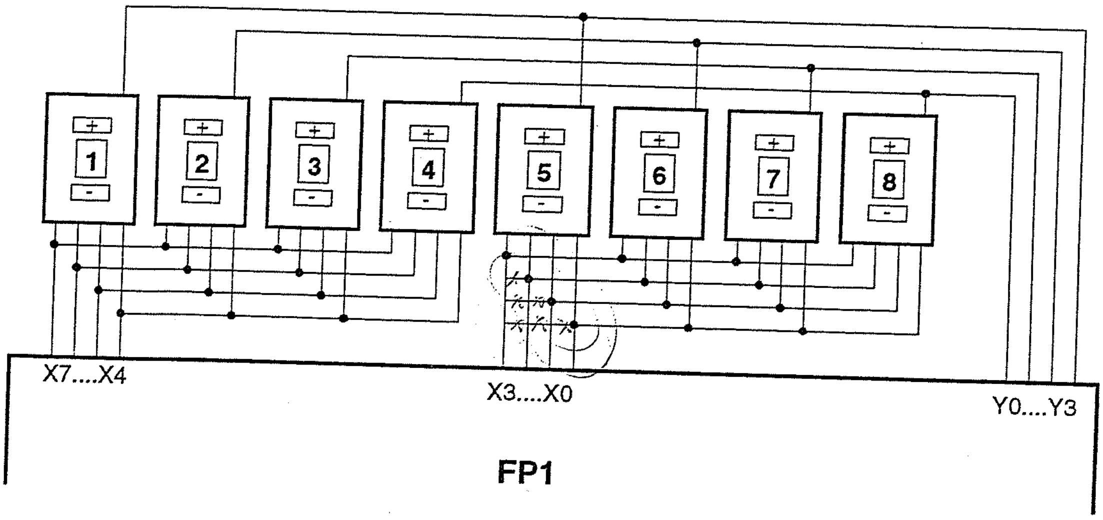
8-digit Digital Switch Input

Outline

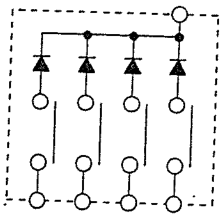
Data of the 8 digital switches, which usually requires 32 inputs, can be taken into FP-M/FP1 only with 8 inputs and 4 outputs.

Configurations (NPN type example)

- FP1 programmable controller
- 8 digital-switches *



* Use digital switches with diodes to prevent influences from other digital switches



Explanation of example

- By cyclically shifting the ON output relay from Y0 to Y3, F1 selects two from 8 digital switches for to be recognized at the following I/O update.
The data taken to the FP1 are stored in the DT0 to DT3 and DT4 to DT7.
WY0 is updated on the way of the scan by the F143 (IORF) instruction.

Program example [File: SAMPL016]

```
    |R9014                                                    | Encodes 4 bits of WR0 and
 0  |--| |------[ F92  ENCO, WR 0 , H 2 ,  IX      ]          | stores the result IX
    |           [ F6   DGT , WX 0 , H 0 , IXDT 0  ]          | Transfers data in the hexadecimal
    |           [ F6   DGT , WX 0 , H 1 , IXDT 4  ]          | digit position 0 of WX0 to DT0~DT3.
    |           [ F101 SHL , WR 0 , K 1           ]          | Transfers data in the hexadecimal digit
    |                                                         | position 1 of WX0 to DY4 to DT7
    |                                                         | Shafts ON bit of WR0 to the left
    |R9013                                          R0        |
27  |--| |--+--------------------------------------[ ]--------| When R4 turns ON, R0 goes ON again
    |R4     |                                                 |
    |--| |--+                                                 |
    |R0                                             Y0        |
30  |--| |-----------------------------------------[ ]--------| 1st & 5th digits
    |R1                                             Y1        |
32  |--| |-----------------------------------------[ ]--------| 2nd & 6th digits
    |R2                                             Y2        |
34  |--| |-----------------------------------------[ ]--------| 3rd & 7th digits
    |R3                                             Y3        |
36  |--| |-----------------------------------------[ ]--------| 4th & 8th digits
    |R9010                                                    |
38  |--| |------[ F143 IORF , WY 0 , WY 1 ]                    | Update WY0
```

Note:

- In order to gain time for I/O transition
  - place the program above at smaller address of the program
  - add following program below the above program if you do not need any other program

```
|R9010
|--| |------[ F11  COPY , K 0 , DT 100 , DT500 ]          |
```

CHAPTER 7

DYNAMIC OUTPUT

Availability
All FP-Ms and FP1

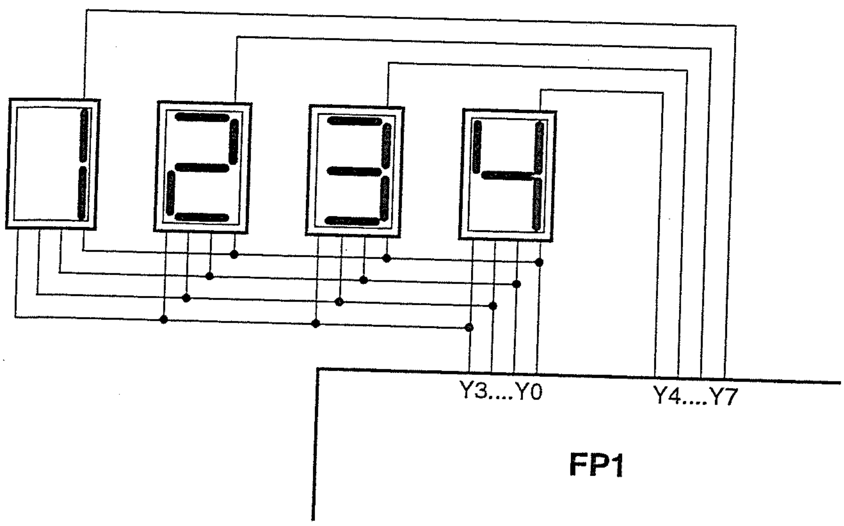
4-digit BCD Indicator

Outline

Data for 4-digit BCD indication, which usually requires 16 outputs, are output to 4 BCD indicators only with 8 outputs. It will take 3 scans for displaying 1 digit.

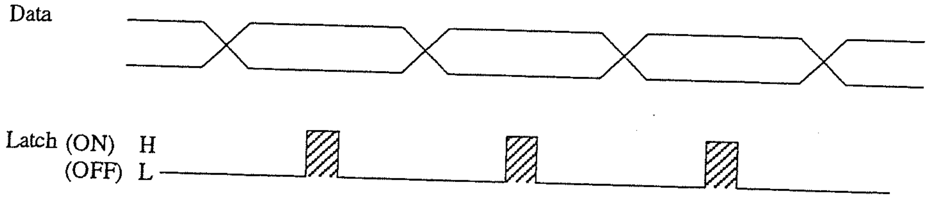
Configurations

- FP1 programmable controller
- 4 BCD indicators *

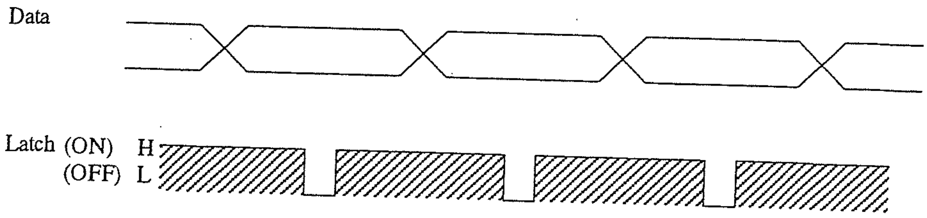


* Use BCD indicators with a data latching function.

- In the program example, the BCD indicators with the latch system blow are used.

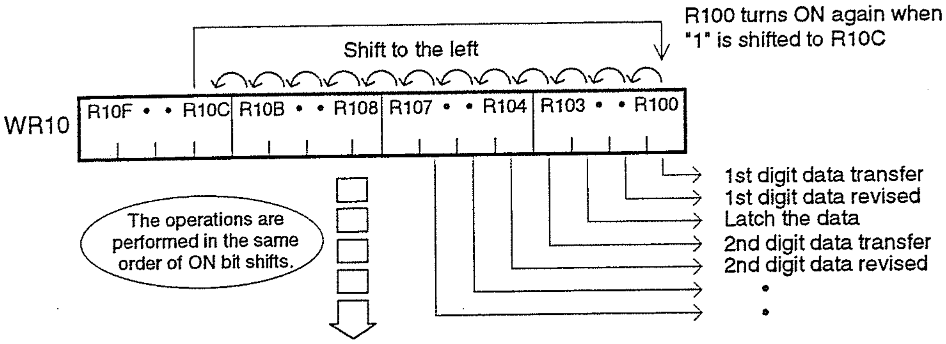


- When the BCD indicators with the latch system below is used, change the program at addresses 47, 49, 51 and 53 to normally open contacts.

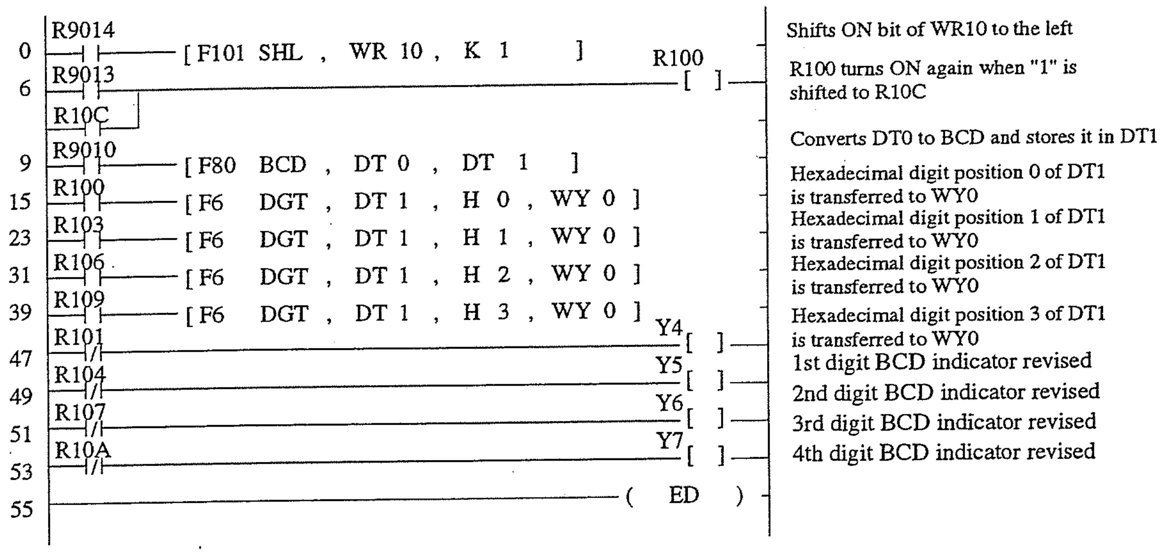


Explanation of example

- By shifting the ON bit of WR10 to the left, data transfer, data revise and latch operations for each digit are performed.



Program example [File: SAMPL017]



8-digit BCD Indicator

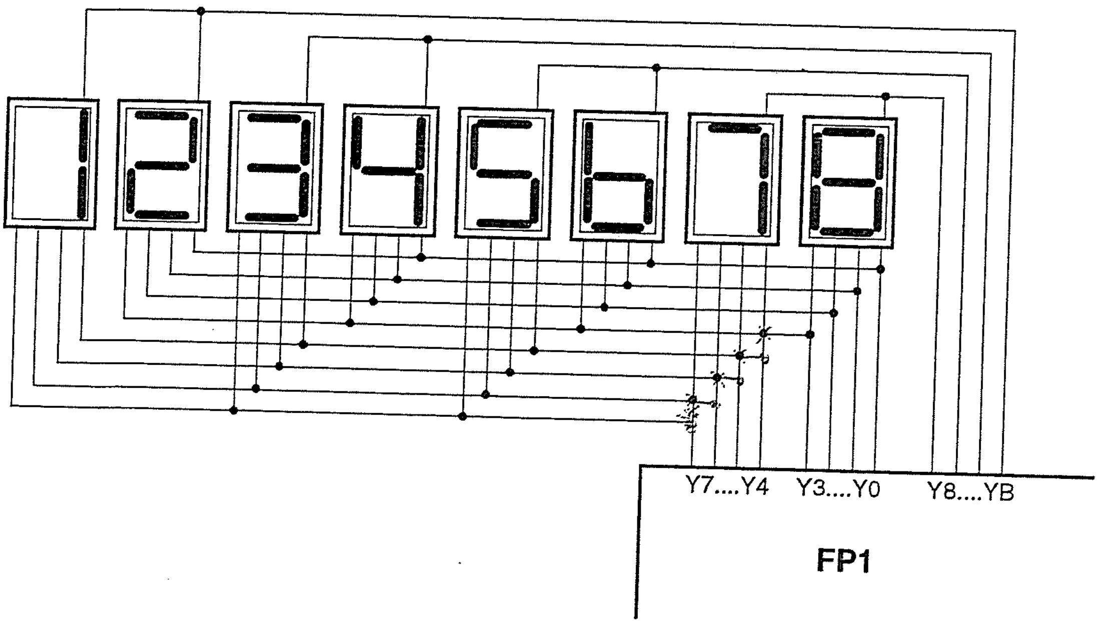
Availability
All FP-Ms and FP1

Outline

Data for 8-digit BCD indication, which usually requires 32 outputs, are output to 8 BCD indicators only with 12 outputs. It will taks 3 scans for displaying 2 digit.

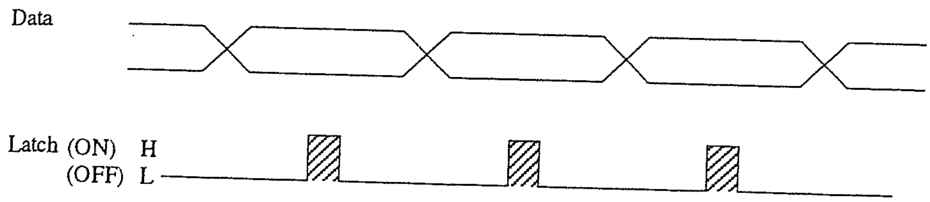
Configurations

- FP1 programmable controller
- 8 BCD indicators *

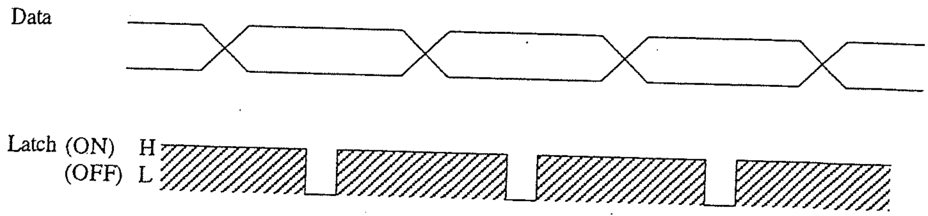


* Use BCD indicators with a data latching function.

- In the program example, the BCD indicators with the latch system blow are used.

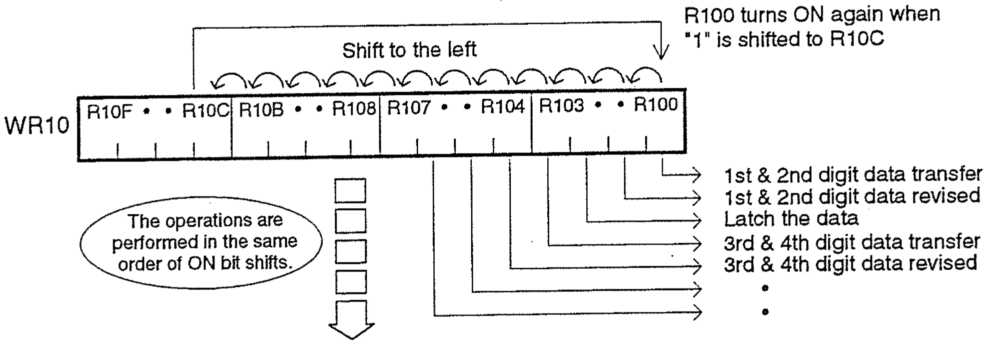


- When the BCD indicators with the latch system below is used, change the program at addresses 49, 51, 53 and 55 to normally open contacts.



Explanation of example

- By shifting the ON bit of WR10 to the left, data transfer, data revise and latch operations for each digit are performed.



Program example [File: SAMPL018]

```
     R9014
 0  ─┤ ├──────[ F101 SHL , WR 10 , K 1 ]                     Shifts ON bits of WR10 to the left
     R9013                                     R100
 6  ─┤ ├─────────────────────────────────────[ ]─            R100 turns ON again when "1" is
     R10C                                                     shifted to R10C
    ─┤ ├─┘
     R9010                                                    Converts DT1 and DT0 to BCD and
 9  ─┤ ├──────[ F82 DBCD, DT 0 , DT 2 ]                       stores it in DT3 and DT2
     R100                                                     Transfers hexadecimal digit positions
17  ─┤ ├──────[ F6 DGT , DT 2 , H 10 , WY 0 ]                 0 and 1 of DT2
     R103                                                     Transfers hexadecimal digit positions
25  ─┤ ├──────[ F6 DGT , DT 2 , H 12 , WY 0 ]                 2 and 3 of DT2
     R106                                                     Transfers hexadecimal digit positions
33  ─┤ ├──────[ F6 DGT , DT 3 , H 10 , WY 0 ]                 0 and 1 of DT3
     R109                                                     Transfers hexadecimal digit positions
41  ─┤ ├──────[ F6 DGT , DT 3 , H 12 , WY 0 ]                 2 and 3 of DT3
     R101                                      Y8
49  ─┤/├─────────────────────────────────────[ ]─            1st and 2nd digit BCD indicator revised
     R104                                      Y9
51  ─┤/├─────────────────────────────────────[ ]─            3rd and 4th digit BCD indicator revised
     R107                                      YA
53  ─┤/├─────────────────────────────────────[ ]─            5th and 6th digit BCD indicator revised
     R10A                                      YB
55  ─┤/├─────────────────────────────────────[ ]─            7th and 8th digit BCD indicator revised
57  ──────────────────────────────────────( ED )─
```

CHAPTER 8

10-KEY INPUT

Availability
All FP-Ms and FP1

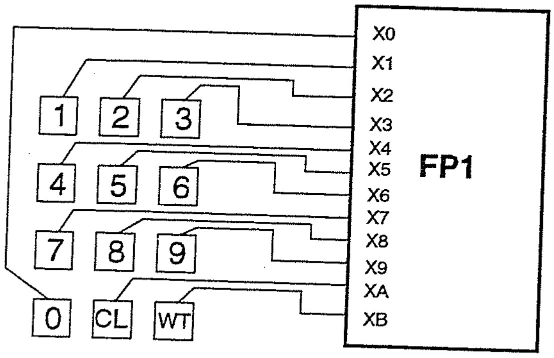
10-key Input

Outline

Using a 10-key unit, 8-digit of numerical data is input to FP-M/FP1

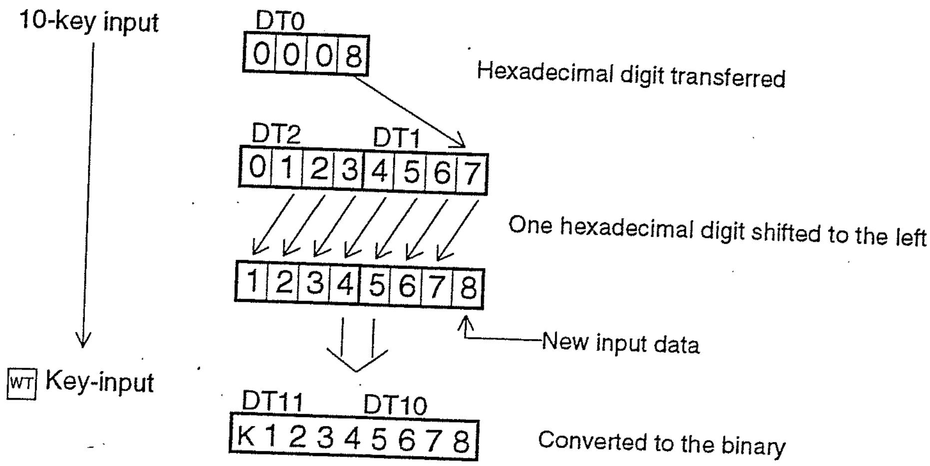
Configurations

- FP1 programmable controller
- 10-key unit



Explanation of example

Once a numerical key of the 10-key unit is pressed, the pressed data is stored in DT0 in the BCD format using F92 (ENCO) instruction and then the input data (1 digit) is transferred to the lower 4-bit of DT1. Each time a new data is input, the data in the DT2 and DT1 is shifted to the left in 4-bit units. When the WT key is pressed, data stored in the DT2 and DT1 is converted to the binary data and stored in DT11 and DT10.



The CL key clears the data in the DT2 and DT1 but not clears the data in the DT11 and DT10

Program example [File: SAMPL019]

```
    X0   X1   X2   X3   X4   X5   X6   X7   X8   X9          R0
 0 |-|/|--|/|--|/|--|/|--|/|--|/|--|/|--|/|--|/|--|/|--(DF/)--[ ]-|
    R0
12 |-| |--[ F92  ENCO , WX 0 ,  H  4 ,  DT 0  ]                  |  Encodes the WX0
    R0
20 |-| |--[ F113 WBSL, DT 1 ,  DT 2  ]                           |  Shifts one hexadecimal
    R0                                                               digit to the left
26 |-| |--[ F6   DGT , DT 0 ,  K 0 ,  DT 1  ]                    |  Transfers the lower 4-bit
    XA                                                               of DT0 to DT1
34 |-| |--( DF )------------------------------------------> 1    |
   |-1 >--[ F1   DMV , K  0 ,  DT 1  ]                           |
    XB
43 |-| |--( DF )------------------------------------------> 1    |
   |-1 >--[ F83  DBIN , DT 1 ,  DT 10  ]                         |
```

If you need to keep the BCD data unconverted, change the program as follows:

```
    XB
43 |-| |------( DF )--------------------------------> 1 |
   |- >1 -----[ F83  DBIN,  DT 1 , DT 10  ]             |
               ~~~~~~~~~~
                  ↓
    XB
43 |-| |------( DF )--------------------------------> 1 |
   |- >1 -----[ F 1  DMV,   DT 1 , DT 10  ]             |
               ~~~~~~~~~~
```

10-key Input & BCD Indication

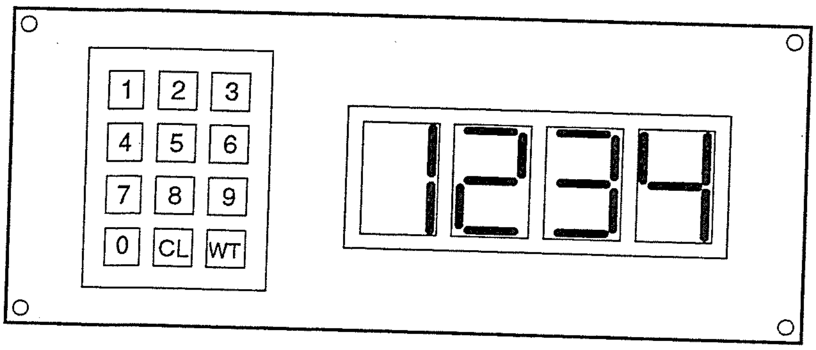
Availability
All FP-Ms and FP1

Outline

Using a 10-key unit and 4-digit BCD indicator, 4-digit decimal data is stored in the specified data register.

Configurations

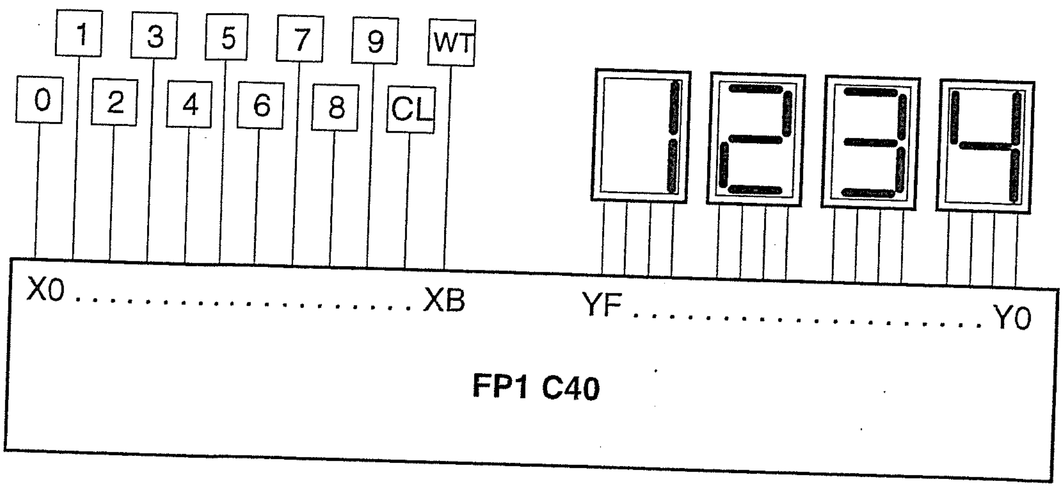
- FP1 C40 programmable controller
- 10-key unit
- 4-digit BCD indicator



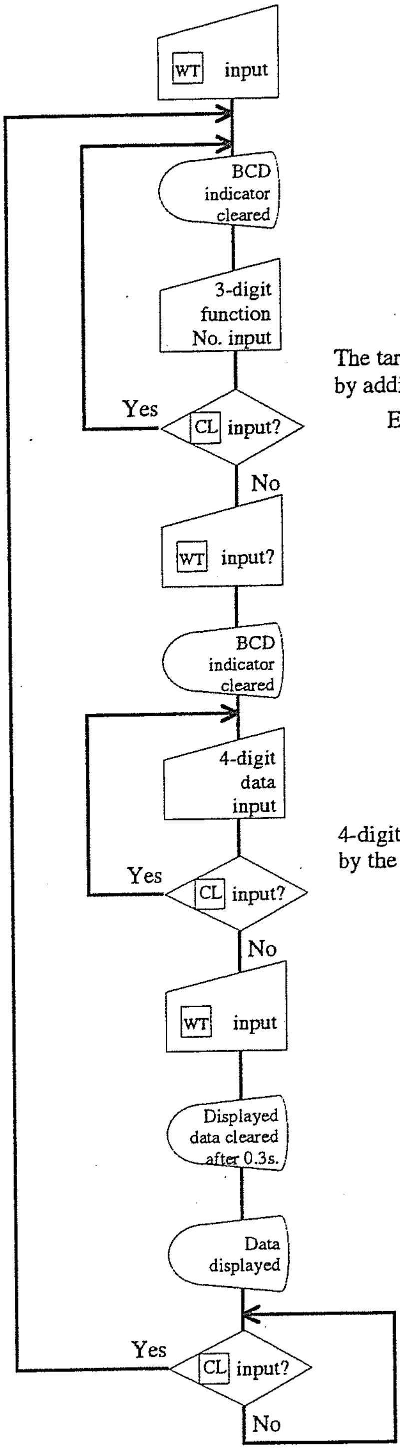
1 ~ 9 Numerical key

CL Clear key

WT Write key



Explanation of example



The target DT address can be obtained by adding 200 to the input data.

Example: Input "000" → DT200
Input "150" → DT350

4-digit data is stored in the DT specifed by the procedure above.

* When the CL key is pressed longer than 0.5s. during the settings, all the setting are cleared.

- F92 (ENCO) instruction:
  In order to take a numerical value into FP1, F92 (ENCO) instruction is used at the program address of 114. In the example, the data in the R10 to R1F is encoded and the result is stored in DT2 as a binary data as show in the example below.

When [8] key is pressed:

[9] [8] [7] [6] [5] [4] [3] [2] [1] [0]   X8 turns On

R19	R18	R17	R16	R15	R14	R13	R12	R11	R10
0	1	0	0	0	0	0	0	0	0

R18 turns ON

Encode processing

DT2	K8

Binary data for expressing K8 is stored in DT2.

- F6 (DGT) instruction:
  In order to display and store input data correctly, the F6 (DGT) instruction is used as shown in the example below:

When [2][4][6] is pressed:

By pressing the [2] key, K2 is transferred to DT2

DT2

15---	---8	7---	---0
0000	0010	0000	0010

Hexadecimal digit position 0 of DT2 is transferred to the hexadecimal digit position 2 of DT4 and WY0.

DT4
WY0

15---	---8	7---	---0
0000	0010	0000	0000

By pressing the [4] key, K4 is transferred to DT2

DT2

15---	---8	7---	---0
0000	0010	0000	0100

Hexadecimal digit position 0 of DT2 is transferred to the hexadecimal digit position 1 of DT4 and WY0.

DT4
WY0

15---	---8	7---	---0
0000	0010	0100	0010

By pressing the [6] key, K4 is transferred to DT2

DT2

15---	---8	7---	---0
0000	0010	0000	0110

Hexadecimal digit position 0 of DT2 is transferred to the hexadecimal digit position 0 of DT4 and WY0.

DT4
WY0

15---	---8	7---	---0
0000	0010	0100	0110

2 4 6

Program example [File: SAMPL020]

```
  0  R9013 --+-- [F0  MV   , K 2    , DT0        ]   Initial settings for data area
     R20   --+   [F0  MV   , K 3    , DT1        ]
                 [F11 COPY , H  0   , DT2 , DT6  ]
                 [F0  MV   , K 0    , IX         ]
                 [F0  MV   , H FFFF , WY0        ]
 31  X0 ---- TMR 0   5 -- (DF) ------------- R10 [ ]   [0] key input  (Key monitaring)
 37  X1 ---- TMR 1   5 -- (DF) ------------- R11 [ ]   [1] key input
 43  X2 ---- TMR 2   5 -- (DF) ------------- R12 [ ]   [2] key input
 49  X3 ---- TMR 3   5 -- (DF) ------------- R13 [ ]   [3] key input
 55  X4 ---- TMR 4   5 -- (DF) ------------- R14 [ ]   [4] key input
 61  X5 ---- TMR 5   5 -- (DF) ------------- R15 [ ]   [5] key input
 67  X6 ---- TMR 6   5 -- (DF) ------------- R16 [ ]   [6] key input
 73  X7 ---- TMR 7   5 -- (DF) ------------- R17 [ ]   [7] key input
 79  X8 ---- TMR 8   5 -- (DF) ------------- R18 [ ]   [8] key input
 85  X9 ---- TMR 9   5 -- (DF) ------------- R19 [ ]   [9] key input
 91  XA ---- TMR 10 10 -- (DF) ------------- R20 [ ]   [CL] key input (all clear)
 97  XA ---- (DF) -------------------------- R21 [ ]   [CL] key input (clear)
100  XB ---- (DF) -------------------------- R22 [ ]   [WT] key input
103  R10 --+-------------------------------- R23 [ ]   [0]~[9] keys input
     R11 --+
     R12 --+
     R13 --+
     R14 --+
     R15 --+
     R16 --+
     R17 --+
     R18 --+
     R19 --+
114  R23 ---- [F92 ENCO , WR 1 , H 4 , DT2 ]           Pressed key value is stored in DT2
122  R31 -/- R32 -/- R33 -/- R34 -/- ------- R30 [ ]   (Function No. input stage)
                                                       Function No. setting starting condition
127  R23 --- R30 -------------------------- > 1        Hexadecimal position 0 of DT0
     1 > ---- [F6  DGT , DT 0 , H 200 , DT 3 ]         to 2 of DT3
              [F6  DGT , DT 2 , DT 3  , DT 4 ]         According to the code specified
              [F6  DGT , DT 2 , DT 3  , WY 0 ]         by DT3, data is transferred to
                                                       DT4 and WY0
              [F37 -1  , DT 0 ]                        Decrement DT0
              [F60 CMP , K- 1 , DT 0 ]
158  R23 --- R30 --- R900B ---------------- > 1        After 3 key inputs are detected
     1 > ---- [F0  MV  , K 2  , DT 0 ]                 DT0 is initialized
166  R23 --- R30 --+ R900B -+- R21 -/- R35 -/- R36 -/- R31 [ ]   Function No. ends input
     R31 ----------------+
                                                       (Function No. fix stage)
174  R22 --+ R31 --- R21 -/- R35 -/- ------- R32 [ ]   [WR] key input
     R32 --+
180  R32 ---- (DF) ------------------------ > 1        BCD indicator clear
     1 > ---- [F0  MV  , H FFFF , WY0 ]
```

```
187  R23  R32
     -| |--| |---------------------------------------> 1   (Data input stage)
     > 1 --- [F6  DGT , DT 1 , H 200 , DT 5 ]            Hexadecimal digit 0 of DT1 is transferred
                                                         to hexadecimal digit 2 of DT5
             [F6  DGT , DT 2 , DT 5 , DT 6 ]             According to the code specified by DT5,
             [F6  DGT , DT 2 , DT 5 , WY0 ]              data in DT2 is transferred to DT6 and
                                                         WY0
             [F37 -1  , DT 1 ]                           Decrement DT1
             [F60 CMP , K- 1 , DT 1 ]
218  R23  R32  R900B
     -| |--| |--| |----------------------------------> 1   Initialize DT1 when 4th input
     > 1 --- [F0  MV  , K 3 , DT 1 ]                     is detected
226  R23  R32  R900B  R21   R35   R37              R33
     -| |--| |--| |--+-|/|--|/|--|/|-------------[ ]---  Data input end
     R33             |
     -| |------------+
                                                         (Data fix stage)
234  R22  R33  R21   R35                           R34
     -| |--| |-+-|/|--|/|------------------------[ ]---  [WR] key input
     R34       |
     -| |------+
240  R34
     -| |----- (DF) ---------------------------------> 1   (Display & data clear stage)
     1 > --- [F0  MV  , H FFFF , WY0 ]                   Display clear
             [F81 BIN , DT 4 , IX ]                      DT4 → IX
             [F81 BIN , DT 6 , IXDT 200 ]                According to IX data in DT6
                                                         is transferred
257  R34        TMX   3                            R35
     -| |-------[    ]---(DF)--------------------[ ]---
                11
263  R35                                                 After 0.3s, data in the DT6 is
     -| |----- [F0  MV  , DT 6 , WY0 ]                   displayed again
269  R30       R21                                 R36
     -| |--+---| |-------------------------------[ ]---  (Clear stage 1)
     R31  R32  |                                         [CL] key is pressed while setting
     -| |--|/|-+                                         function No.
275  R36
     -| |----- [F0  MV  , H 2 , DT 0 ]                   H2 → DT0
               [F0  MV  , H 0 , DT 2 ]                   H0 → DT2
               [F0  MV  , H 0 , DT 3 ]                   H0 → DT3
               [F0  MV  , H 0 , DT 4 ]                   H0 → DT4
               [F0  MV  , K 0 , IX ]                     K0 → IX
               [F0  MV  , H FFFF , WY0 ]                 Display clear
306  R32  R33  R21                                 R37
     -| |--|/|-+--| |----------------------------[ ]---  (Clear stage 2)
     R33  R34  |                                         [CL] key is pressed while data is
     -| |--|/|-+                                         input
313  R37
     -| |----- [F0  MV  , H 2 , DT 1 ]                   H2 → DT0
               [F0  MV  , H 0 , DT 2 ]                   H0 → DT2
               [F0  MV  , H 0 , DT 5 ]                   H0 → DT3
               [F0  MV  , H 0 , DT 6 ]                   H0 → DT4
               [F0  MV  , K 0 , IX ]                     K0 → IX
               [F0  MV  , H FFFF , WY0 ]                 Display clear
344  --------------------------------------------( ED )
```

CHAPTER 9

CLOCK/CALENDAR FUNCTION

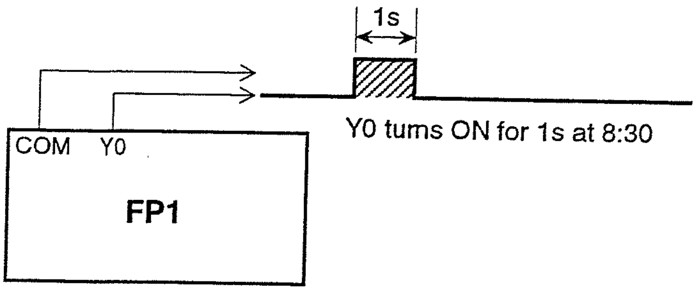
Automatic Start Operation at the Specific Time of a Day

Availability
FP-M C20TC, C32TC and C20RC types and FP1 C24C, C40C, C56C and C72C types

Outline Y0 turns ON for 1s during at 8:30 am everyday.

Configurations

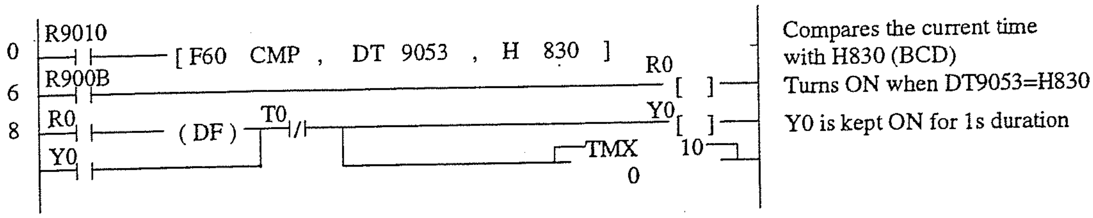
- FP1 programmable controller



Explanation of example

Comparing the clock/calendar data stored in the DT9053 with H830 (BCD), Y0 is turned ON once a day for 1s duration.

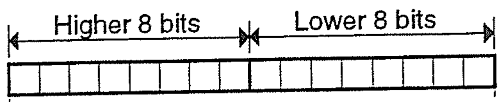
Program example [File: SAMPL021]



Settings

Using a data of day of week, you can also turn Y0 ON at 8:30 am at Mondays.

- The data is stored in BCD as:



DT9054	Minute H00 to H59 (BCD)	Second H00 to H59 (BCD)
DT9055	Day H01 to H31 (BCD)	Hour H00 to H23 (BCD)
DT9056	Year H00 to H99 (BCD)	Month H01 to H12 (BCD)
DT9057	————	Day of week H00 to H06 (BCD)

- Data of the clock/calendar are stored in DT9054, DT9055, DT9056, and DT9057.
  These registers are available both for settings and for monitoring the clock/calendar.

- When setting the clock/calendar by using **F0 (MV)** instructions, the revised setting becomes effective from the time when the most significant bit of DT9058 becomes "1".

Availability
FP-M C20TC, C32TC and C20RC types and FP1 C24C, C40C, C56C and C72C types

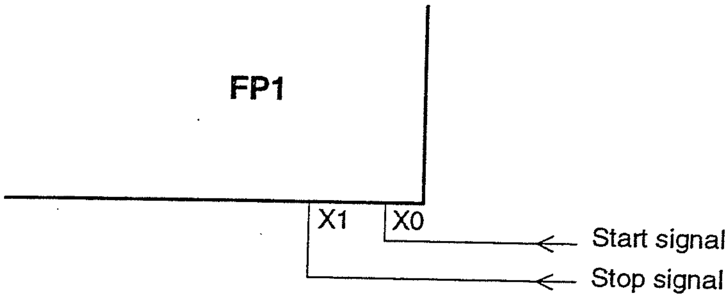
Measuring Time between Two Events

Outline

Time duration between two events are measured using the clock/ calendar within a same day.

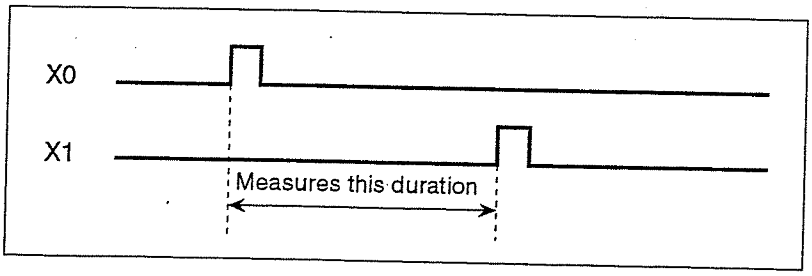
Configurations

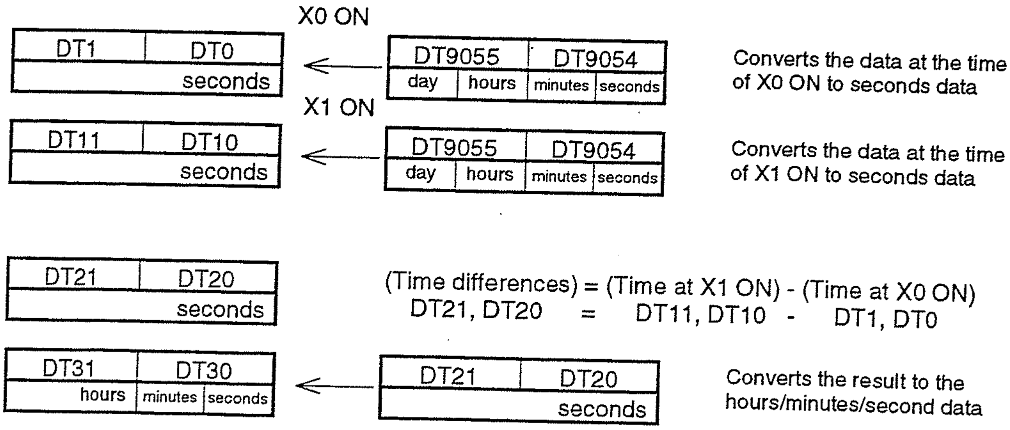
- FP1 programmable controller



Explanation of example

When X0 turns ON, the hours/minutes/seconds data at the time is converted to seconds data and transferred to DT1 and DT0.
When X1 turns ON, the hours/minutes/seconds data at the time is converted to seconds data and transferred to DT11 and DT10.
Differences between (DT11, DT10) and (DT1, DT0) are calculated by F48 (DB-) instruction and then the result is converted to the hours/minutes/ seconds data and stored in DT31 and DT30.





Program example [File: SAMPL022]

```
0  |R9010
   |--| |---( DF ) ------------------------------------------- > 1
   |- 1 >---[ F138 HMSS ,  DT 9054  ,  DT  0  ]
7  |X0
   |--| |---( DF ) ------------------------------------------- > 1
   |- 1 >---[ F138 HMSS ,  DT 9054  ,  DT 10  ]
   |-       [ F48  DB-  ,  DT 10    ,  DT 0 ,  DT  20 ]
   |-       [ F139 SHMS ,  DT 20    ,  DT 30  ]
   |
```

When the leading edge of X0 is detected, clock data is converted to seconds data and stored in DT1 and DT0

When the leading edge of X1 is detected: clock data is converted to seconds data and stored in DT11 and DT10.

(DT11, DT10) - (DT1, DT0) = (DT21, DT20)

Data in DT21 and DT20 are converted to hours/munites/seconds data and stores it to DT31 and DT30.

Availability
FP-M C20TC, C32TC and C20RC types and FP1 C24C, C40C, C56C and C72C types

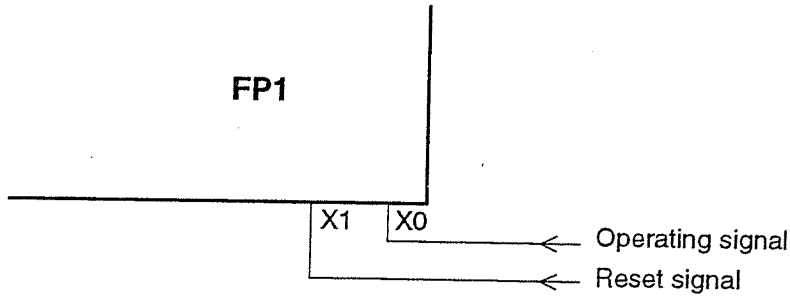
Adding up the Operating Time in a Day

Outline

Machine's operating time in a day is calculated using the clock calendar function.

Configurations

- FP1 programmable controller



Explanation of example

ON time of X0 is stored in DT2. When the X0 turns OFF, a new and accumulated data are added up and stored in the DT11 and DT10.
If the X1 turns ON, the data stored in the DT0 to DT11 is cleared.

DT1		DT0	
0	hours	minutes	seconds

When X0 turns ON, the data at the starting time is stored in Dt1 and DT0

DT3		DT2	
0	hours	minutes	seconds
0	0	0	0

While X0 is in the On state;
(Current time) - (Starting time) = (ON time)
(DT9055, DT9054) - (DT1, DT0) = (DT3, DT2)

← When X0 is in the OFF state, DT3 and DT2 become K0

DT5	DT4
	seconds

←

DT3		DT2	
0	hours	minutes	seconds

The ON time of X0 is converted to seconds data and stored in DT5 and DT4.

DT7	DT6
	seconds

←

DT11		DT10	
0	hours	minutes	seconds

At the trailing edge of X0, data in DT11 and DT10 is converted to seconds data and stored in DT7 and DT6.

DT9	DT8
	seconds

(X0 ON time) + (Previous total) = (New total)
DT4 + DT6 = DT8

DT11		DT10	
0	hours	minutes	seconds

←

DT9	DT8
	seconds

Converts second data to hours/minutes/seconds data

Program example [File: SAMPL023]

```
      X0
 0  --| |--- ( DF ) ------------------------------------ > 1   X0 ON start
    - 1 >---[ F0   MV   , DT 9054 , DT 0 ]                     Stores the starting time to DT0
                                                                 | DT1   | DT0   |
                                                                 | 0 | h | min | s |
            [ F6   DGT  , DT 9055 , H 10  , DT 1 ]
      X0
14  --| |---[ F158 CSUB , DT 9054 , DT 0  , DT 2 ]             Calculating X0 ON time
                                                                 (Current time) - (Starting time) =
            [ F6   DGT  , H    0  , H 210 , DT 3 ]                  Transfers NO  | DT3   | DT2   |
      X0                                                                          | 0 | h | min | s |
31  --|/|---[ F1   DMV  , K       0 , DT 2 ]                   DT3 and DT2 cleared during X0 OFF
      X0
39  --| |--- ( DF / ) ---------------------------------- > 1   Converts the data in the DT10 to seconds data
                                                               and stores the result to DT10 to DT6
    - 1 >---[ F138 HMSS , DT 10   , DT 6 ]
      R9010                                                    Converts X0 ON time to       | DT5 | DT4     |
46  --| |---[ F138 HMSS , DT 2    , DT 4 ]                     seconds data and stores DT4  |     seconds   |
            [ F48  DB+  , DT 4    , DT 6 , DT 8 ]              New total data is stored in DT9 and DT8
                                                                 DT8 = (X0 ON time) + (Old ON time)
            [ F139 SHMS , DT 8    , DT 10 ]                    New data is converted to hours/minutes/
      X0                                                       seconds data and stores it   | DT9 | DT8     |
68  --| |---[ F11  COPY , K 0     , DT 0 , DT 11 ]             to DT11 and 10               |     seconds   |
76  ------------------------------------------------ ( ED )    Clears DT0 to DT11                 ↓
                                                               when X1 turns ON             | DT11  | DT10  |
                                                                                            | 0 | h | min | s |
```

Availability
FP-M C20TC, C32TC and C20RC types and FP1 C24C, C40C, C56C and C72C types

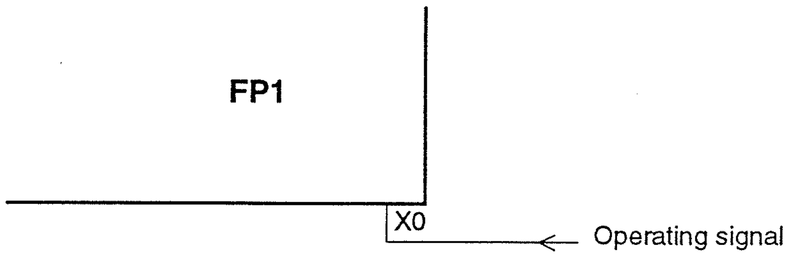
Storing the Operating Time of a Week

Outline

Memorizes the operating time of a week using the clock/calendar functions.

Configurations

- FP1 programmable controller



Explanation of example

While X0 is in the ON state, data in the DT0 is increased by one each ON-minute. Data stored in the DT0 is shifted to DT1 when the time in the DT9053 becomes H2359 and DT0 is reset when the data in DT9053 becomes H0000.

Program example [File: SAMPL024]

```
    |X0   T0
 0  |--| |--| |---( DF ) ------------------------------ > 1 -| DT0 is increased by 1 each time 1 minutes
    |                                                        | is elapesed during X0 ON states
    |- 1 >---[ F35  +1    ,  DT  0  ]                        -|
    |R9010
 6  |--| |---[ F60  CMP   ,  DT  9053   ,  H   2359  ]       -| Compares the current time with H2359
    |R900B                                        R0
12  |--| |--- ( DF ) ---------------------------------[  ]   -| R0 turns ON when DT9053 = H2359
    |R0
15  |--| |---[ F111 WSHL ,  DT  0      ,  DT  6     ]        -| Shifts one word to the left
    |R9010
21  |--| |---[ F60  CMP   ,  DT  9053   ,  H      0  ]       -| Compares the current time with H0000
    |R900B                                        R1
27  |--| |--- ( DF ) ---------------------------------[  ]   -| R1 turns ON when DT9053 becomes NO
    |R1
30  |--| |---[ F0   MV    ,  K   0      ,  DT 0     ]        -| Resets DT0
    |T0
36  |--|/|-------------------------------------[ TMY    60 ] -| 1 min clock relay
    |                                              0
```