3. PROGRAMLAMA

3.1. Komut Kelimeleri

3.1.1. PLC Komut Kümesi

Symbol	Name	Function
LOD	Load	Reads out the I/O status after storing an intermediate result.
AND	AND	Logical AND
O R	OR	Logical OR
OUT	Output	Output
MCS	Master Control Set	Starts a master control.
MCR	Master Control Reset	Ends a master control.
SOT	Singlt Output	Leading-edge differentiation
TIM	Timer	Timer
CNT	Counter	Counter
SFR	Shift Register	Shift register
END	End	Ends a program.
SET	Set	Sets an output, internal relay or shift register.
RST	Reset	Resets an output, internal relay or shift register.
JMP	Jump	Jumps a designated program area.
JEND	Jump End	Ends a jump program.
NOT	NOT	Inversion
FUN	Function	Sets function and computing instructions.

3.1.2. Fonksiyon Komutları

FUN No.	Contents of Instructions
FUN100 to FUN146	Coincidence comparison instructions for the counter's counted values
FUN200 to FUN246	Larger/smaller comparison instructions for the counter's counted values
FUN147	Computing instruction
FUN247	Computing instruction
FUN300	Addressed jump instruction
TIM FUN	External display instruction for the timer's counted values
CNT FUN	External display instruction for the counter's counted values

3.1.3. Hesaplama Komutları

FUN147 [a] → [a]	Type
1	BCD→BIN conversion
2	BIN→BCD conversion
3	4-digit comparison
4	Addition (+)
5	Subtraction (-)
6	Multiplication (×)
7	Division (÷)
8	Data register data shift
9	BCD digit left shift
10	Data load (16-bit)
11	Data load (8-bit)
12	Data load (indirect)
13	Data load (16-bit)
14	Data load (8-bit)
18	Data increment
19	Data decrement
20	Data store (16-bit)
21	Data store (8-bit)
22	Data store (indirect)
23	Data store (16-bit)
24	Data store (8-bit)
25	Data display (dynamic)

3.2. Komut Biçimi

Address	Instruction	First Address	Second Address
One-address Instructions	LOD AND OR OUT SET RST SOT	Instruction word and number	
	AND·LOD OR·LOD MCS MCR JMP JEND END	Instruction word	
Two-address Instructions	SFR SFR NOT	Instruction word and initial number	No. of bits for shift register
	TIM CNT FUN100-146 FUN200-246	Instruction word and timer/counter numbers	Preset value or comparison data
	TIM FUN CNT·FUN	Instruction word and timer/counter numbers	Output initial No.
	FUN147	Instruction word	Operation instruction code
	FUN300	Instruction word	Address No. for jump destination

3.3. Birimlerin Ayrılmış Numaraları

FA-1J Serisi Ayrılmış Bütün Numaralar

Name	Allocation No.	No. of Points
Input	0-7, 10-17, 20-27, 30-37, 40-47, 50-57, 60-67, 70-77	64
Output	200-207, 210-217, 220-227, 230-237, 240-247, 250-257, 260-267, 270-277	64
Internal Relay	400-407, 410-417, 420-427, 430-437, 440-447, 450-457, 460-467, 470-477, 480-487, 490-497, 500-507, 510-517, 520-527, 530-537, 540-547, 550-557, 560-567, 570-577, 580-587, 590-597, 600-607, 610-617, 620-627, 630-637, 640-647, 650-657, 660-667, 670-677, 680-687, 690-697	240
Special Internal Relay	700-707, 710-717	16
Timer	0-79 (When using arithmetic operand: 100-1079)	80
Counter	0-44 (When using arithmetic operand: 900-944)	45
Reversible Counter	45 (dual pulse), 46 (up/down selection) (When using arithmetic operand: 945 & 946)	1 each
Shift Register	0-127 (bidirectional)	128
Single Output	0-95	96
Data Register	800-899 (DR0-99)	100

FA-1J Serisi Giriş/Çıkışın Ayrılmış Numaraları

For I/O numbers, the input has fixed numbers from 0 to 77 and the output has fixed numbers from 200 to 277. The I/O numbers of each expansion unit are allocated automatically in sequence from the nearest to the CPU unit.

(Ex. 1) 72 I/Os

CPU	0-7 10-17 16-input	20-27 30-37 16-input	40-47 8-input
	Relay output 200-207	16-Tr. output 210-217 220-227	8-Tr. output 230-237

(Ex. 2) 40 I/Os

CPU	0- 7 10-17 16-input	Dummy	Dummy
	Relay output 200-207	Relay output 210-217	Realy output 220-227

(Ex. 3) 40 I/Os

CPU	0- 7 10-17 16-input	210-217 Relay output
	Relay output 200-207	Relay output 220-227

(Ex. 4) 32 I/Os

CPU	0-7 AC 8-input	10-17 AC 8-input	20-27 AC 8-input
	Relay output 200-207	Dummy	Dummy

(Ex. 5) 32 I/Os

CPU	0-7 AC 8-input	20-27 AC 8-input
	AC 8-input 10-17	Relay output 200-207

FA-1J Serisi Özel Rölelerin Ayrılmış Numaraları

No.	Function	
700	Unused	
701	Start control	
702	Start control	
703	All output OFF	
704	Initialize pulse (Turns ON for 1 scan when starting)	
705	Unused	
706	Numerical value error	
707	(CY) Carry & Borrow	
710	Greater than (>) comparison operation	
711	Equal to (=) comparison operation	
712	Smaller than (<) comparison operation	
713	1-sec timer reset	
714	1-sec clock (duty 1:1)	For readout only
715	100-msec clock (duty 1:1)	"
716	Timer/counter preset value changed	"
717	In-operation output	"

FA-1J Serisi Özel Rölelerin Fonksiyonları

701 & 702 Start control

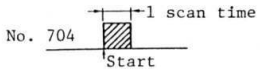
When start input of Input No. 0 is turned ON, or when automatic start is designated by setting 500 via FUN61, the FA-1J starts upon turning on special internal relay 701, and then 702. It stops when these relays are turned OFF.

703 All outputs OFF

When No. 703 is turned ON, all outputs (Nos. 200 to 277) go OFF.
The self-holding circuits using outputs (Nos. 200 to 277) also go OFF, and do not reset even when No. 703 is turned OFF. Internal relays and shift registers remain unchanged.

704 Initialize pulse

When the FA-1J starts operation, No. 704 goes ON only for one scan.



706 Numerical value error

No. 706 is turned ON when operation by a computing instruction results in a data error.

707 (CY) Carry & Borrow

Sets carry and borrow of operation result via computing instruction.

710, 711 & 712 Comparison operation

Compares designated data with those of data register via computing instruction.
No. 710 turns on when:
Register data > Operand data
No. 711 turns on when:
Register data = Operand data
No. 712 turns on when:
Register data < Operand data

713 1-sec clock reset

While No. 713 is ON, No. 714 (1-sec clock) is always placed in the reset mode.

714 1-sec clock

While No. 713 is OFF, No. 714 generates clock pulses oscillating at 500msec ON and 500msec OFF (duty ratio 1:1).

715 100-msec clock

No. 715 always generates clock pulses oscillating at 50msec ON and 50msec OFF.

716 Timer/counter preset value modified

When the program loader is used to modify timer/counter preset values for the FA-1J CPU unit, No. 716 goes ON. No. 716 is cleared when a program is written into the memory pack by pressing TRS, ENTR and ENTR keys or the memory pack is replaced.

717 In-operation output

No. 717 is always ON during FA-1J operation.

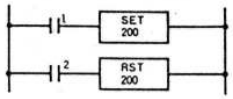
3.4. Temel Komutların Çalışması ve Özellikleri

SET (Set)

RST (Reset)

Basic

• Sample relay circuit

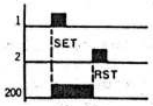


• Program list

Address	Inst'n Word	Data
0	LOD	1
1	SET	200
2	LOD	2
3	RST	200

• Key operation

• Outputs, internal relays and shift registers can be set (ON) or reset (OFF), using the SET or RST instruction.



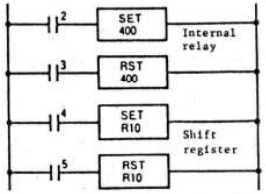
Supplementary

1. The range in which the SET RST instructions can be used.

Function	Number
Output	200 to 277
Internal relay	400 to 697
Special relay	700 to 713
Shift register	0 to 127

Note: SET and RST instructions operate only when the input signal is changed from the off-state to the on-state.

2. Sample program



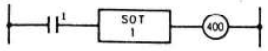
Inst'n Word	Data
LOD	2
SET	400
LOD	3
RST	400
LOD	4
SET	R10
LOD	5
RST	R10

3. Double application of SET/RST instructions
The same output can be set in double for SET and RST instructions.

SOT (Single output)

Basic

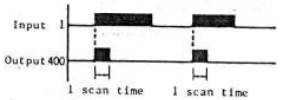
- Sample relay circuit



- Program list

Address	Inst'n Word	Data
0	LOD	1
1	SOT	1
2	OUT	400

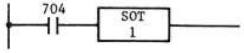
- The instruction converts (differentiates) the input signal to a one-shot signal.
- The SOT turns the SOT output ON only for a period of one scan when the input signal is turned ON.
- When a relay output is designated, it may not operate depending on the scan time.
- 96 SOT instructions (0 to 95) can be used.

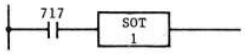


Note 1: If operation is started with input signal ON, the SOT output does not turn ON. To turn on the SOT output, input signal must turn on after starting operation.

Note 2: If an SOT instruction is used between MCS and MCR instructions and input signal to the SOT instruction turns ON before or at the same time as the input signal to the MCS instruction, the SOT output does not turn ON.

Note 3: If special relay 704 (initialize pulse) or 717 (in-operation output) is used as input signal to the SOT instruction, the SOT output does not turn ON.



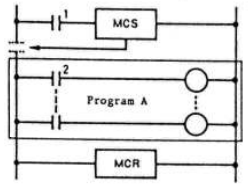


MCS (Master control set)

MCR (Master control reset)

Basic

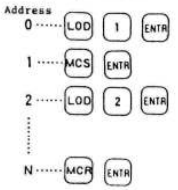
- Sample relay circuit



- Program list

Address	Inst'n Word	Data
0	LOD	1
1	MCS	
2	LOD	2
3		
N	MCR	

- Key operation



- If the input to the MCS instruction is OFF, all inputs of the program (Program A) read after the MCS instruction are forced OFF until the MCR instruction is executed: if the input to the MCS instruction is turned OFF, the program (Program A) up to the MCR is inhibited from operating.
- The MCS instruction should be used in combination with the MCR instruction.

Supplementary

1. Input conditions cannot be set for the MCR instruction.
   When the MCS ends with an MCR (or END), all values of the logical operation value stack register are turned OFF. An END instruction has the same function as the MCR instruction.

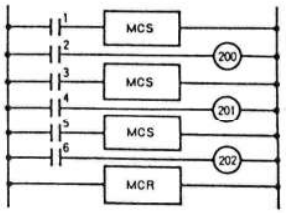
2. Status of each instruction during an MCS instruction execution

Instruction	Status
SOT, OUT	• All instructions are turned OFF.
SET, RST	• All instructions are kept.
TIM	• Counted values and outputs are reset
CNT, SFR	• Counted values are kept. • Pulse inputs are turned OFF. • Outputs are turned OFF.

Note: The MCS instruction execution means that the input conditions are in the off-state.

3. More than one MCS instruction can be set for one MCR instruction.

(Example)



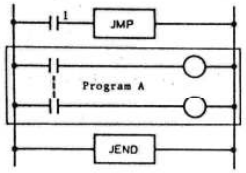
The above master control circuit gives priority to Input 1, Input 3, and Input 5 in this order.

JMP (Jump)

JEND (Jump end)

Basic

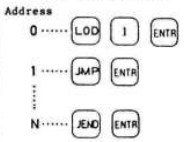
- Sample relay circuit



- Program list

Address	Inst'n Word	Data
0	LOD	1
1	JMP	
	Program A	
N	JEND	

- Key operation



- If the operation result immediately before the JMP instruction is ON, the JMP becomes valid, thus executing the program before the JEND instruction without processing (holding all statuses): if the result is OFF, the JMP becomes invalid, whereby the next program is executed.

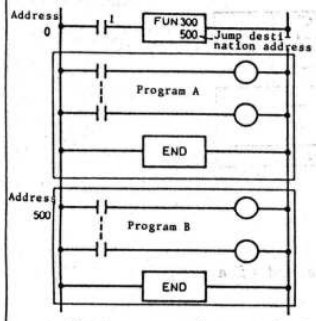
Supplementary

1. It is impossible to program a pair of JMP and JEND instructions between another pair of JMP and JEND instructions.
2. During a JMP instruction execution, the status between the JMP and JEND is held.
   - Outputs, internal relays, timers, counters, and shift registers, are all held in their current statuses.
   - Timer/counter counted values are also held.
   - SOT instructions are all turned OFF.
3. The difference between MCS and JMP is that the program within the JMP instruction is not executed: for example, if the output is ON beforehand, it is being maintained during the execution of the JMP instruction.

FUN300 (Addressed jump instruction)

Basic

- Sample relay circuit



- Program list

Address	Inst'n Word	Data
0	LOD	1
1	FUN	300
2		500
N1	END	
500	LOD	
N2	END	

- Key operation

Address
0 ····· LOD 1 ENTR
1 ····· FUN 3 0 0 ENTR
2 ····· 5 0 0 ENTR
N_1 ····· END ENTR
500 ····· LOD ···
N_2 ····· END ENTR

- If the operation result immediately before this instruction is ON, the program jumps to the designated address (jump destination address), and it is executed from the designated address. If the result is OFF, this instruction is disregarded, and the next instruction is executed.

Supplementary

1. Programming is impossible if the jump destination address is not an address subsequent to the address in which this instruction is set.
2. When a program is modified, be sure to modify the jump destination address. (No automatic modification is made.)
3. The END instruction is required for each program end. Thus, one of the programs will be executed.
4. While a FUN300 instruction is executed, operating conditions before the execution are maintained at addresses between the FUN300 and jump destination.
   However, if jump has been executed during timer operation and the timer input is ON when the timer operation is restored, the counted value of the timer is indefinite.
5. If the input to SOT or CNT instruction at the jump destination is already ON or turns ON simultaneously with jump execution, the input is not turned ON or accepted. After turning OFF, the subsequent input is accepted.
6. Programs skipped by a JUMP instruction are not included in the scan time.

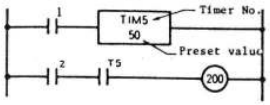
TIM (Timer)

- Three types of subtracting timers can be selectively used according to the allocation number.
  ① Timer Nos. 0 to 79 are 100msec timers.

1. 100msec timer

Basic

- Sample relay circuit



- Program list

Address	Inst'n Word	Data
0	LOD	1
1	TIM	5
2		50
3	LOD	2
4	AND T	5
5	OUT	200

- Key operation

Address
0 ····· LOD 1 ENTR
1 ····· TIM (T) 5 ENTR
2 ····· 5 0 ENTR
3 ····· LOD 2 ENTR
4 ····· AND TIM (T) 5 ENTR
5 ····· OUT 2 0 0 ENTR

- Timer preset values are 0 to 9999.
- When timer instructions are programmed, two addresses are always required. A timer instruction and timer No. should be set at the first address, and the preset value should be set at the second address (always the next address).

Supplementary

1. - When the operation result immediately before this instruction (which is a timer input) is ON, clock pulse counting is initiated.
   - When the counted value reaches the preset time, the timer output turns ON.
   - When the timer input is OFF, the preset value is set.
   - After the time up, the counted value remains at 0 until the timer input turns OFF.
   - The timer cannot use the same number in double. (An error message is displayed when the program is inputted.)
   - If the preset value is changed during subtraction, the timer remains unchanged with the previous preset time for that cycle, and is changed from the next time cycle. (However, if the preset value is changed to 0, the timer stops operation, immediately turning the output ON.)

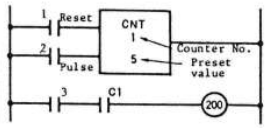
CNT **(Counter)**

- Two types of counters can be selected, depending on their numbers.
  ① Counter Nos. 0 to 44 are adding counters.
  ② Counter Nos. 45 and 46 are reversible counters.

1. Adding counter

Basic

- Sample relay circuit



- Program list

Address	Inst'n Word	Data
0	LOD	1
1	LOD	2
2	CNT	1
3		5
4	LOD	3
5	AND C	1
6	OUT	200

- Key operation

Address
0 ····· LOD 1 ENTR
1 ····· LOD 2 ENTR
2 ····· CNT (C) 1 ENTR
3 ····· 5 ENTR
4 ····· LOD 3 ENTR
5 ····· AND CNT (C) 1 ENTR
6 ····· OUT 2 0 0 ENTR

- 45 adding counters are available: Nos. 0 to 44.
- The counter should be programmed in the order of reset input, pulse input and CNT instruction.
- The counter preset values are 0 to 9999.

Supplementary

1. • When the counter instruction is programmed, two addresses are always required. For the first address, set the counter instruction and counter No., and for the second address, set the preset value.
   - The same number cannot be used in double.
   - While the reset input is OFF, the counter counts the leading edges of pulse inputs, and compares them with the preset value. When the counted value reaches the preset value, the counter turns output ON and the output remains ON until the reset input is turned ON.
   - When the reset input is changed from OFF to ON, the counted value is reset; while the reset input is ON, all pulse inputs are ignored.
   - When power is OFF, the counter's counted value can be held using the FUN (function) designation. (Refer to FUN7). ... (This designates whether the value should be cleared or held at the starting time.)

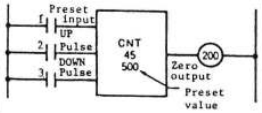
2. Reversible counter

The reversible counters have two types: one is the dual-pulse type (A) having UP and DOWN pulse inputs, and the other is the UP/DOWN selection type (B) with only one pulse input, which switches the up/down gate.

A. Dual-pulse type reversible counter (Counter No. 45)

Basic

- Sample relay circuit

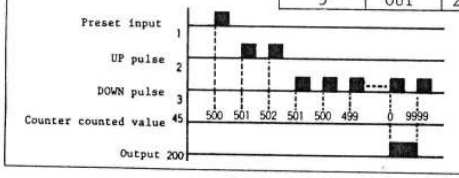


- Program list

Address	Inst'n Word	Data
0	LOD	1
1	LOD	2
2	LOD	3
3	CNT	45
4		500
5	OUT	200

- Key operation

Address
0 ····· LOD 1 ENTR
1 ····· LOD 2 ENTR
2 ····· LOD 3 ENTR
3 ····· CNT (C) 4 5 ENTR
4 ····· 5 0 0 ENTR
5 ····· OUT 2 0 0 ENTR



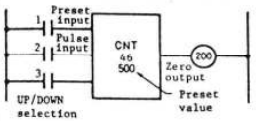
Supplementary

- When the UP pulse and DOWN pulse are ON simultaneously, it may cause the counter not to perform the counting operation.
- Three inputs, i.e. preset input, UP pulse and DOWN pulse are required.
- When the preset input is ON, the preset value is set, and when the preset input is OFF, counting is started.
- The counter output is ON only when the counted value is "0".
- After the counted value reaches 0 or 9999, it changes from 0 to 9999 or from 9999 to 0.
- When a reversible counter is initially programmed and operated, the preset value becomes unconstant (the value remains unsteady) if the preset input is not turned ON; therefore, be sure to design the circuit such that the preset input enters before the counting operation starts.

B. UP/DOWN selection type reversible counter (Counter No. 46)

Basic

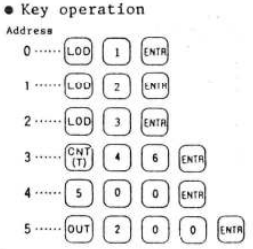
● Sample relay circuit

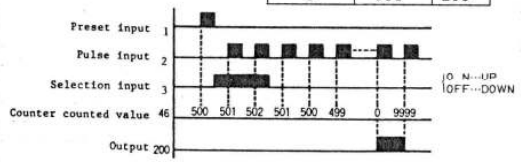


● Program list

Address	Inst'n Word	Data
0	LOD	1
1	LOD	2
2	LOD	3
3	CNT	46
4		500
5	OUT	200

● Key operation





Supplementary

- The UP/DOWN mode is selected for UP when the UP/DOWN selection input is ON and DOWN when it is OFF.

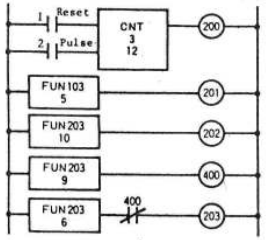
  ON : UP count
  OFF: DOWN count

- The same counter number cannot be used in double.
- When the preset value is changed during counter operation, the new preset value becomes effective immediately. (However, the counter does not operate even if the preset value is changed after the preset value has been reached.)

FUN100 to FUN146 Coincidence comparison instruction for counted values
FUN200 to FUN246 Larger/smaller comparison instruction for counted values

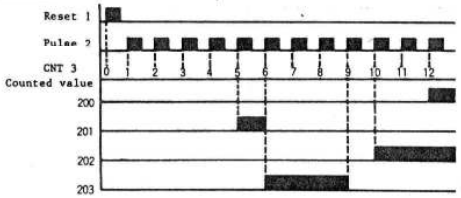
Basic

● Counter multistage setting example



● Program list

Address	Inst'n Word	Data	Address	Inst'n Word	Data
0	LOD	1	9		10
1	LOD	2	10	OUT	202
2	CNT	3	11	FUN	203
3		12	12		9
4	OUT	200	13	OUT	400
5	FUN	103	14	FUN	203
6		5	15		6
7	OUT	201	16	AND NOT	400
8	FUN	203	17	OUT	203



- 47 counters (0 to 46) can perform coincidence comparison and larger/smaller comparison operations with respect to optional values.
- Corresponding to counter Nos. 0 to 46, FUN100 to FUN146 (Counter No. + 100) are coincidence comparison instructions and FUN200 to FUN246 (Counter No. + 200) are larger/smaller comparison instructions.

Supplementary

1. - Regardless of the status of the counter, this instruction merely compares the counted value.
   - Both comparison instructions have the same function as the LOD instruction but they do not have a function corresponding to the AND and OR instructions; therefore, insert an internal relay, for example, whenever necessary.
   - The same FUN number can be used repeatedly for different preset values.