Pertemuan 9

9. Instruksi Lanjut pada PLC Omron

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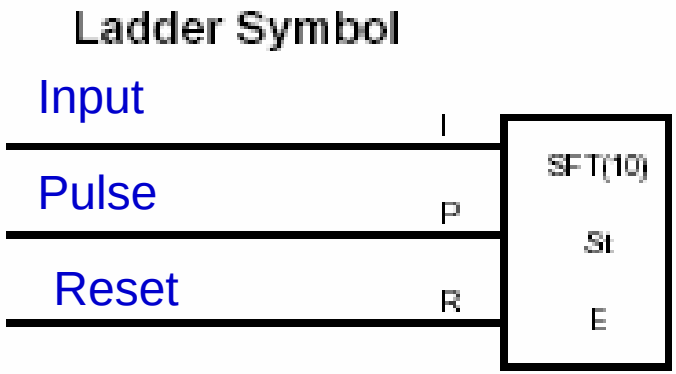
Sasaran

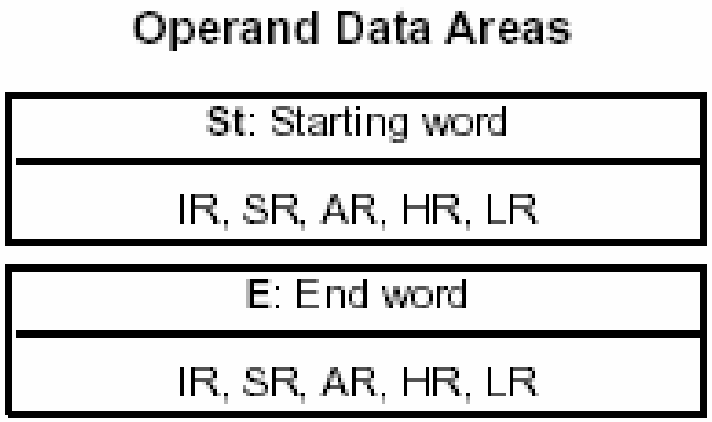
- Mahasiswa mampu :
  - Menerapkan instruksi lanjut dalam pengendalian suatu sistem
  - Memahami cara kerja instruksi lanjut pada PLC Omron

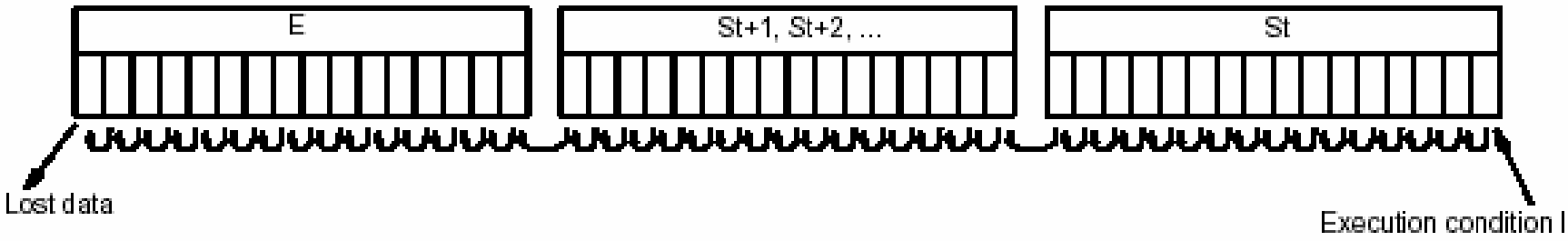
Shift Instruction

- Fungsi :
  - Menggeser satu atau beberapa bit ke kiri atau ke kanan
- Contoh :
  - Shift register – SFT(10)
  - Word shift – WSFT(16)
  - Rotate right – ROR(28)

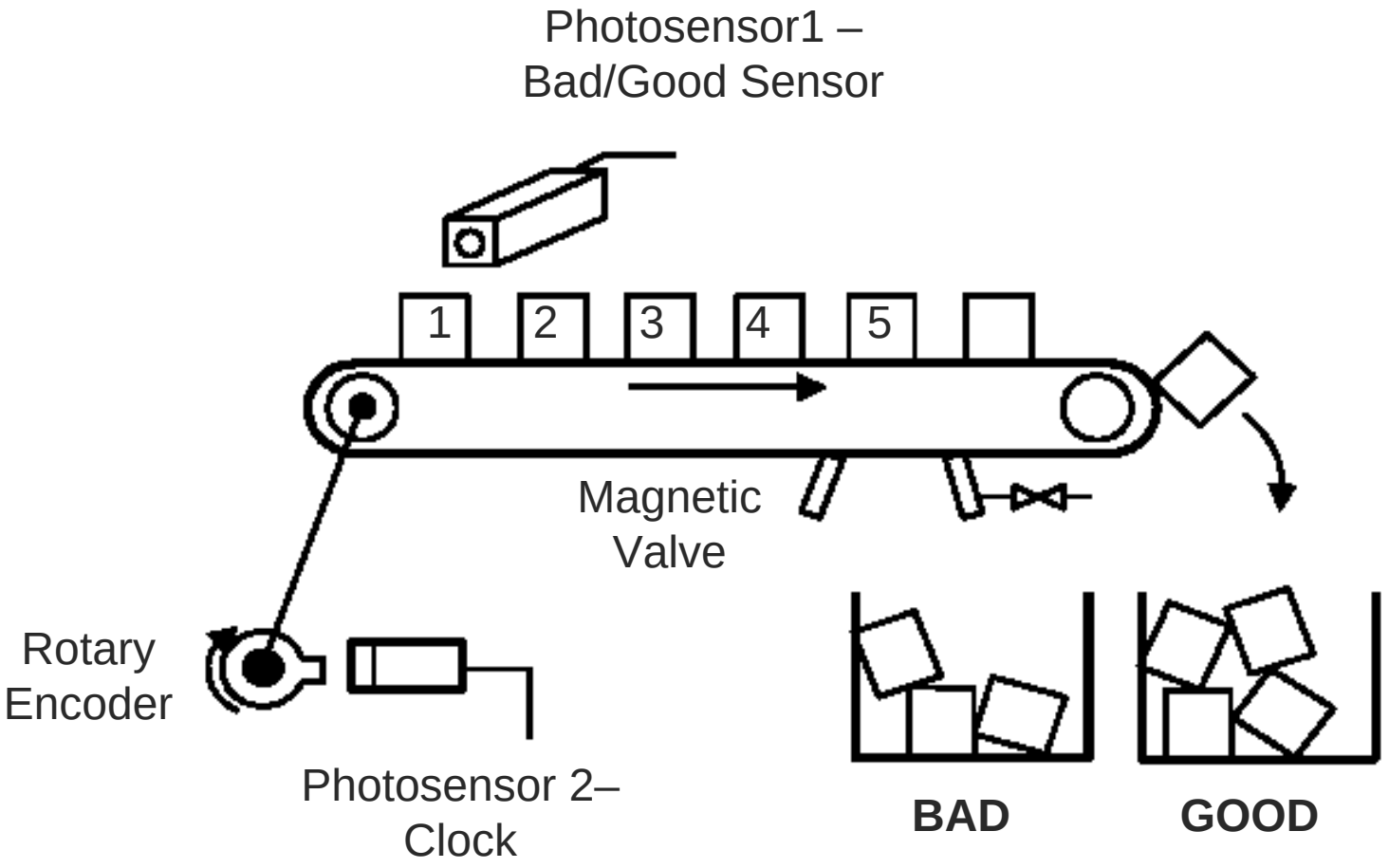
Shift Instruction – Shift Register SFT(10)



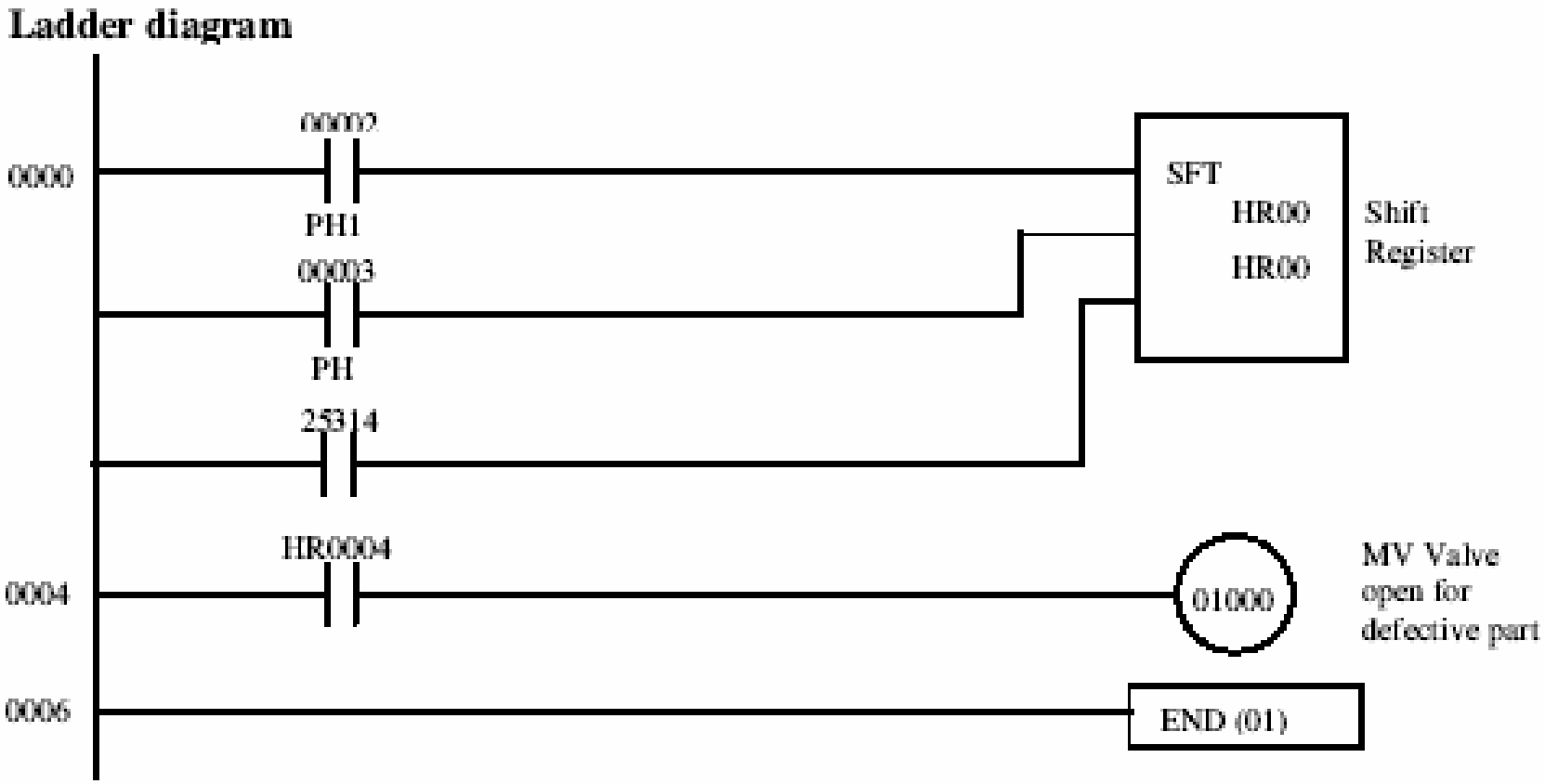




Contoh – Pensortiran barang (1)



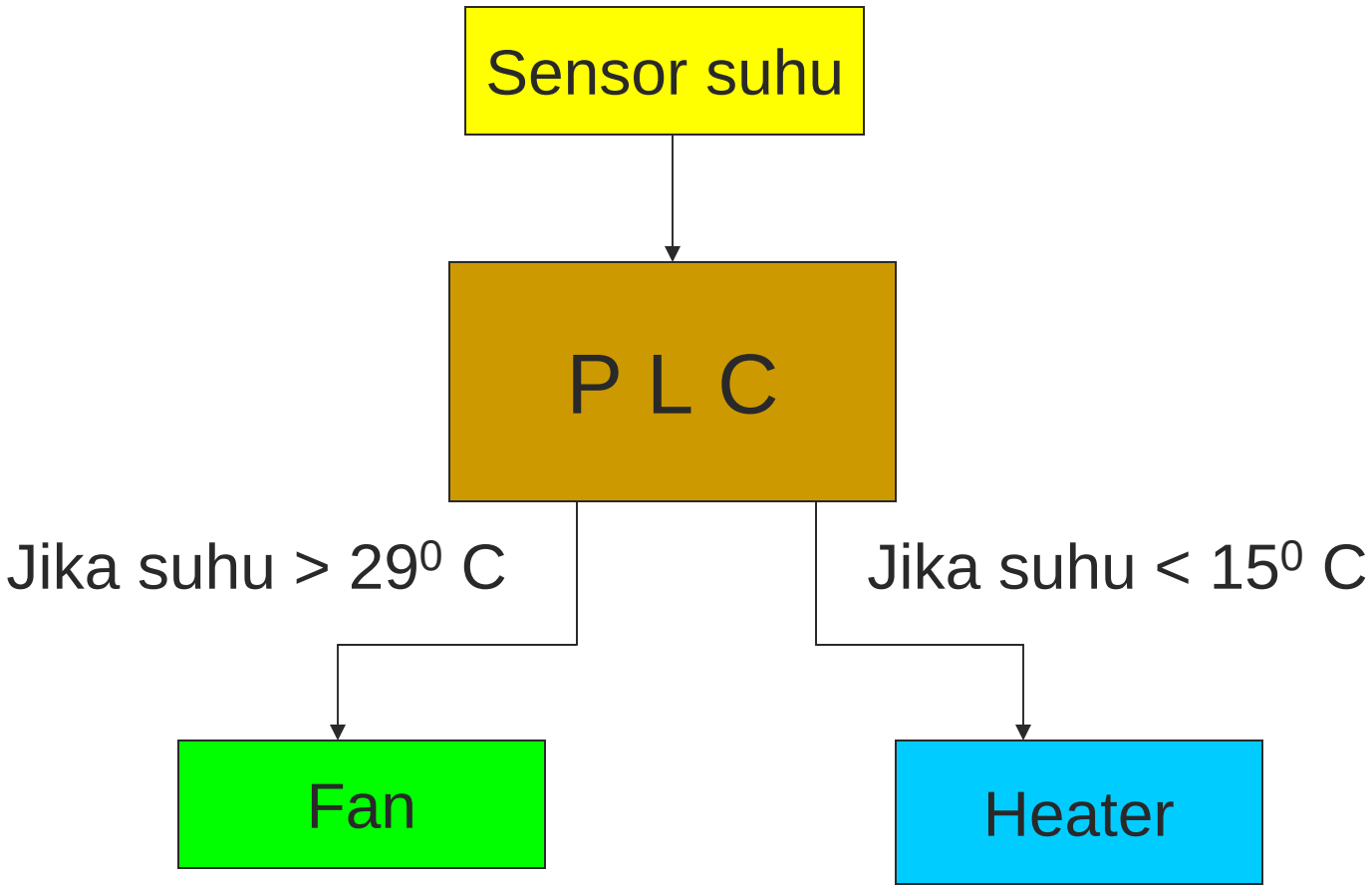
Contoh – Pensortiran barang (2)



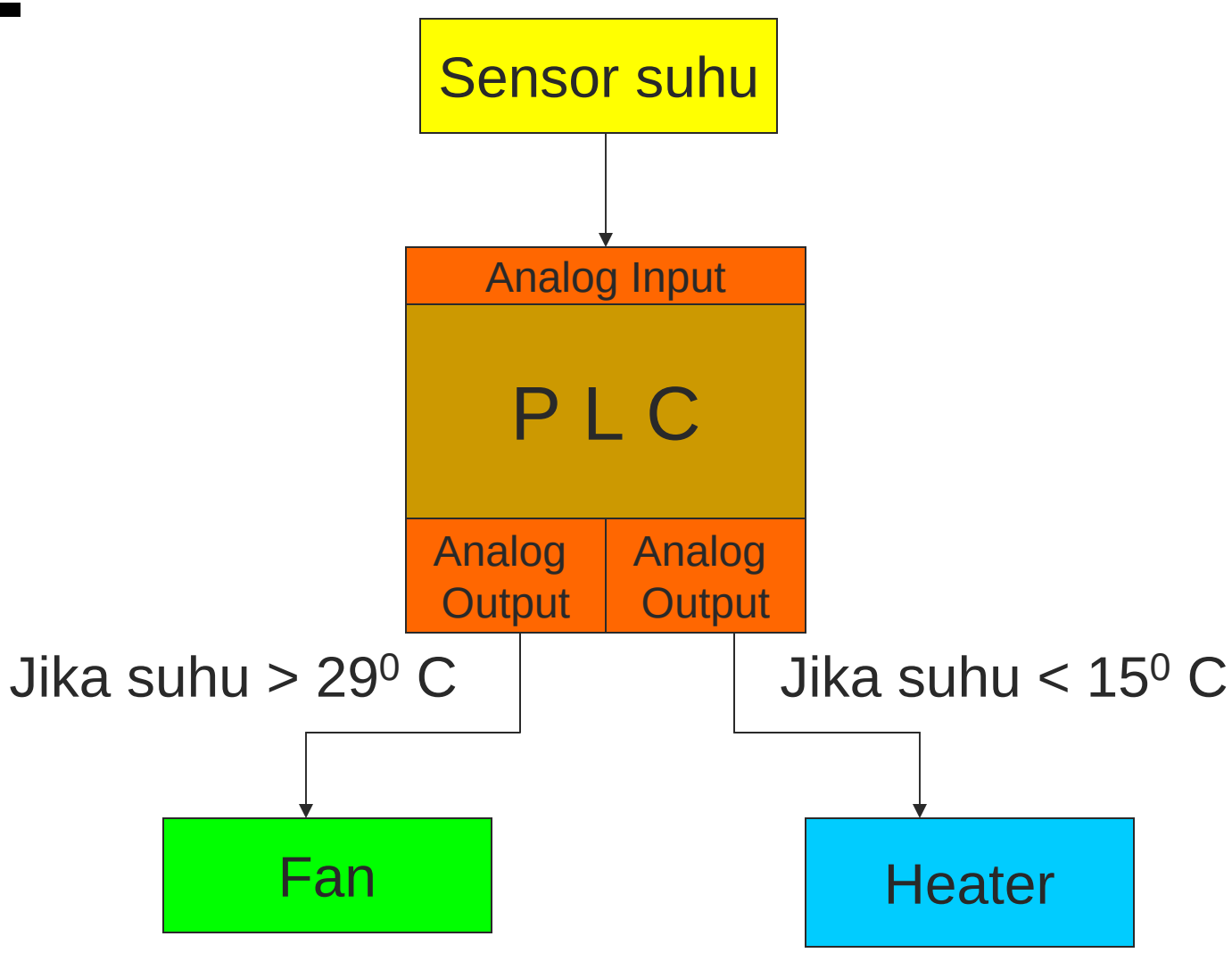
PLC untuk sistem/proses analog? Bagaimana?

- Apakah PLC hanya dapat digunakan untuk sistem diskrit?
- Bagaimana memanfaatkan PLC untuk sistem analog? → lanjut
  - Dengan menggunakan analog input-output
  - Dengan menggunakan instruksi analog

Contoh : sistem pengatur suhu ruangan otomatis (1)



Contoh : sistem pengatur suhu ruangan otomatis (2)



Contoh aplikasi sistem analog

- Sistem perbandingan suhu untuk menyala matikan fan dan heater
- Sistem closed loop + PID
  - Pengaturan suhu
  - Pengaturan kecepatan – posisi motor
- Sistem Lift
- Konversi suhu celsius ke farrenheit
- Dll..

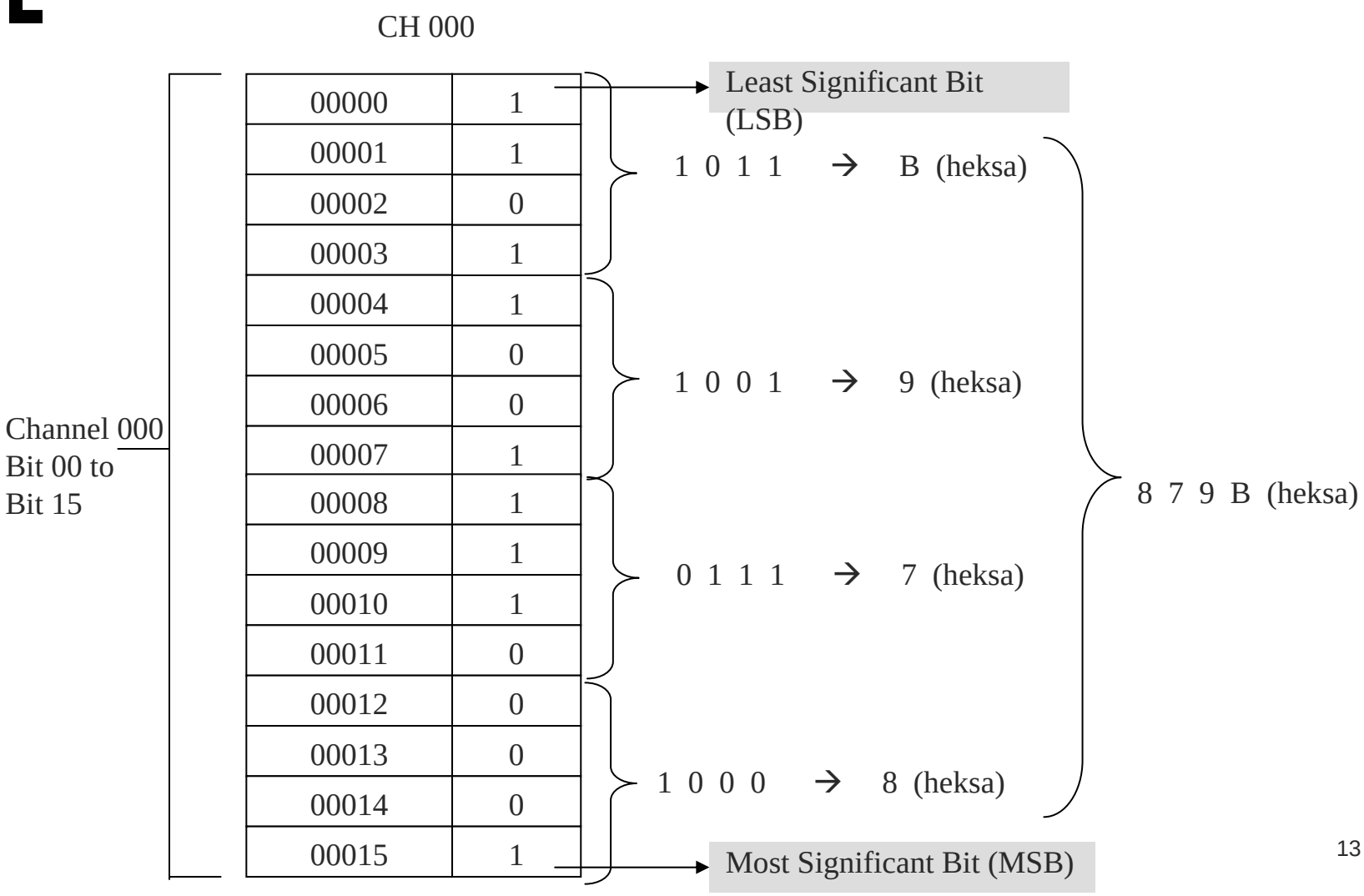
Review – Tipe data pada PLC Addressing

- Bit
  - 1 bit → 1 atau O, ON atau OFF
- Byte
  - 1 byte = 8 bit
- Channel/Word
  - 1 channel/word = 16 bit

Review – Addressing in PLC Omron

- Addressing in bit
  - Hanya menggunakan 1 bit
  - Contoh : IR 00001 → status 1 atau 0
    HR 0000 → status 1 atau 0
- Addressing in Channel
  - Menggunakan 1 channel/word (16 bit)
  - Contoh : IR 000 → nilai 0 – 65535_d ($FFFF_h$)
    HR 00 → nilai 0 – 65535_d ($FFFF_h$)

Review – Channel Addressing w Omron



Instruksi analog – PLC Omron

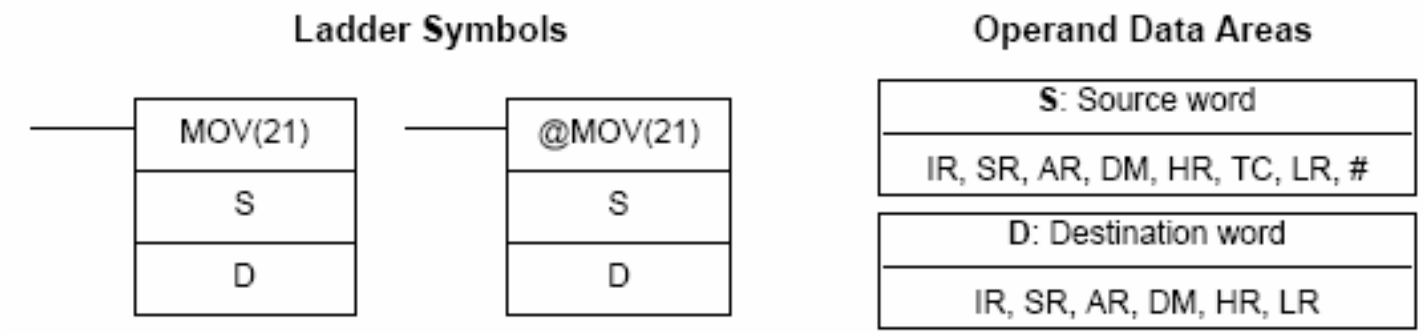
- Selain instruksi bit (manipulasi 1 bit saja), PLC juga memiliki instruksi analog
- Instruksi analog melakukan manipulasi dalam *channel/word* (16 bit)
- Contoh : perpindahan, perbandingan, penjumlahan, pengurangan, dll

Data Movement Instruction

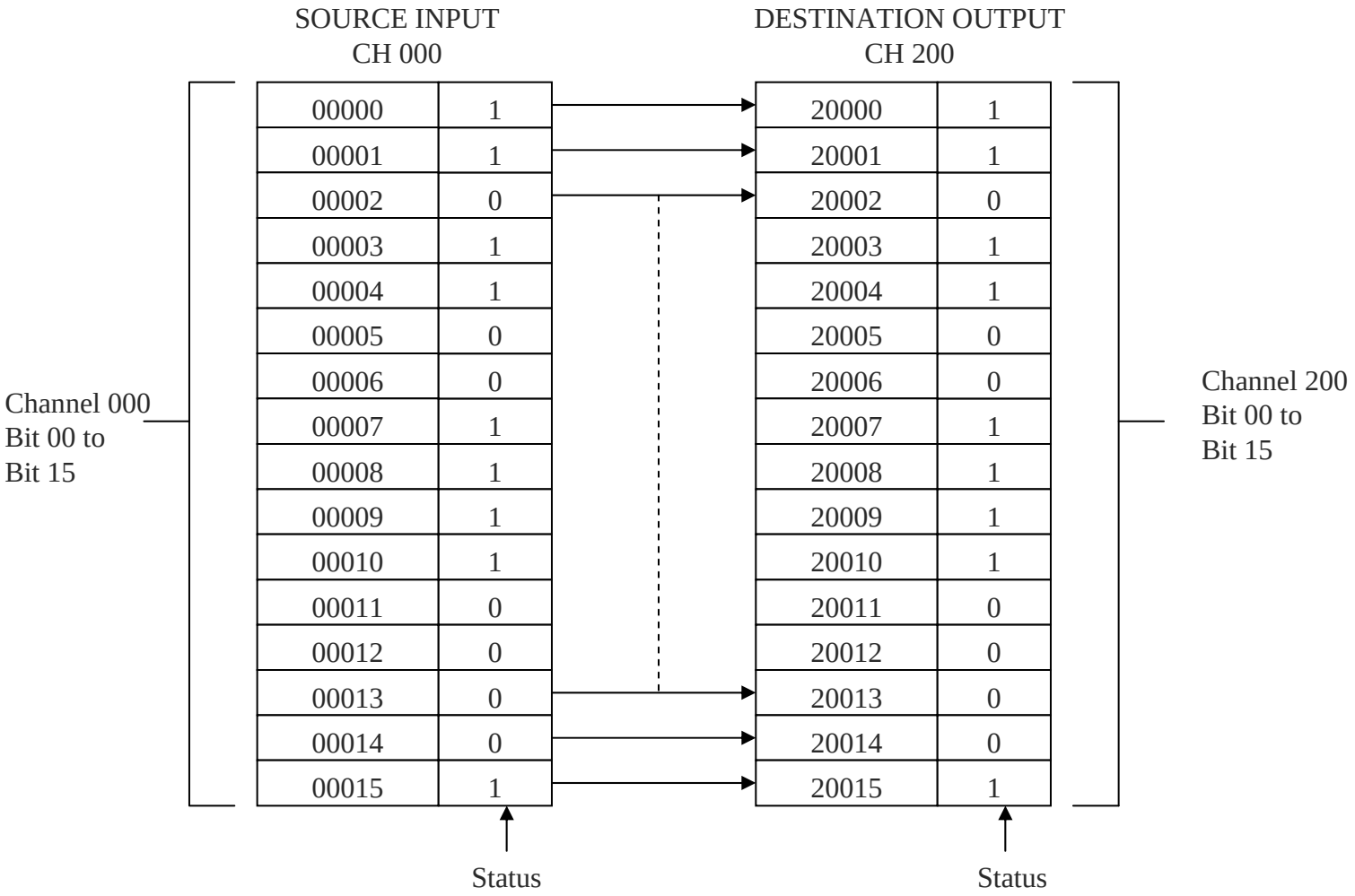
- Perpindahan data secara menumpuki *(replace)* dapat dilakukan dalam :
  - Bit → MOVE BIT – MOVB(82)
  - Digit → MOVE DIGIT – MOVD(83)
  - Word → MOVE – MOV (21)
  - Beberapa Word (Table) → BLOCK TRANSFER – XFER(70)

Data Movement Instruction

- MOV(21)
  - Memindahkan data 16 bit ke alamat tertentu
    - Data (ditandai dengan #) ke alamat lain
    - Isi alamat ke alamat lain
    - Sistem bilangan : **heksadesimal**

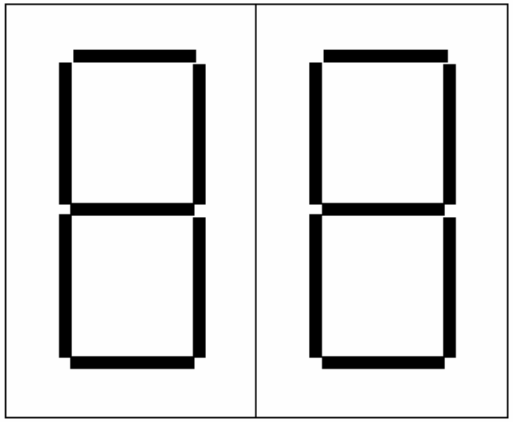


Data Movement Instruction



Contoh : Penampilan kode error plant (1)

Error code



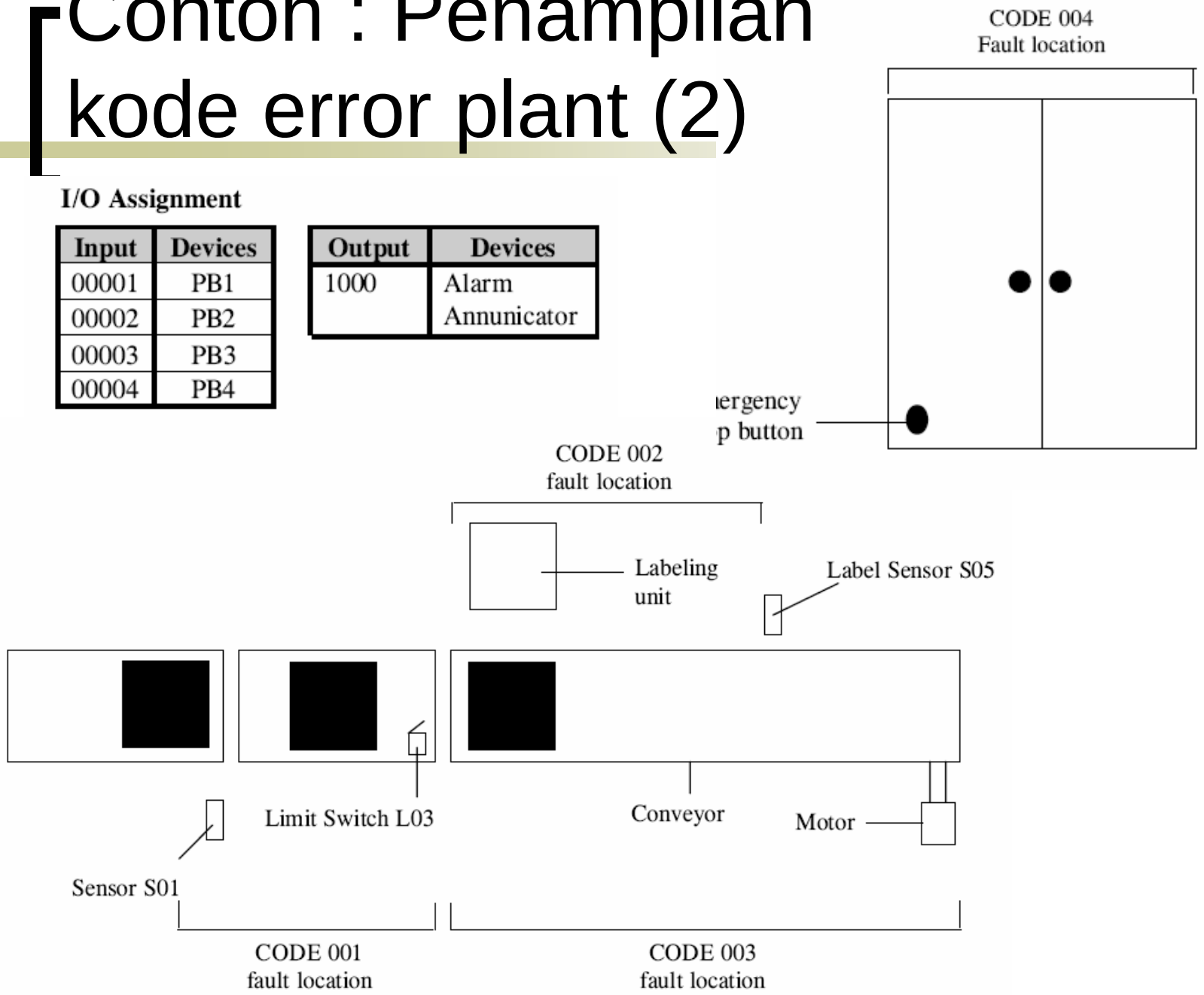
Code	Fault location
001	Feeding section problem Check Sensor No: S01 Check Limit Switch No: L03
002	Labeling Unit Fault Check Contactor No: C01
003	Conveyor Jam Check Label Sensor No: S05
004	Emergency stop Check Emergency Stop button

Contoh : Penampilan kode error plant (2)

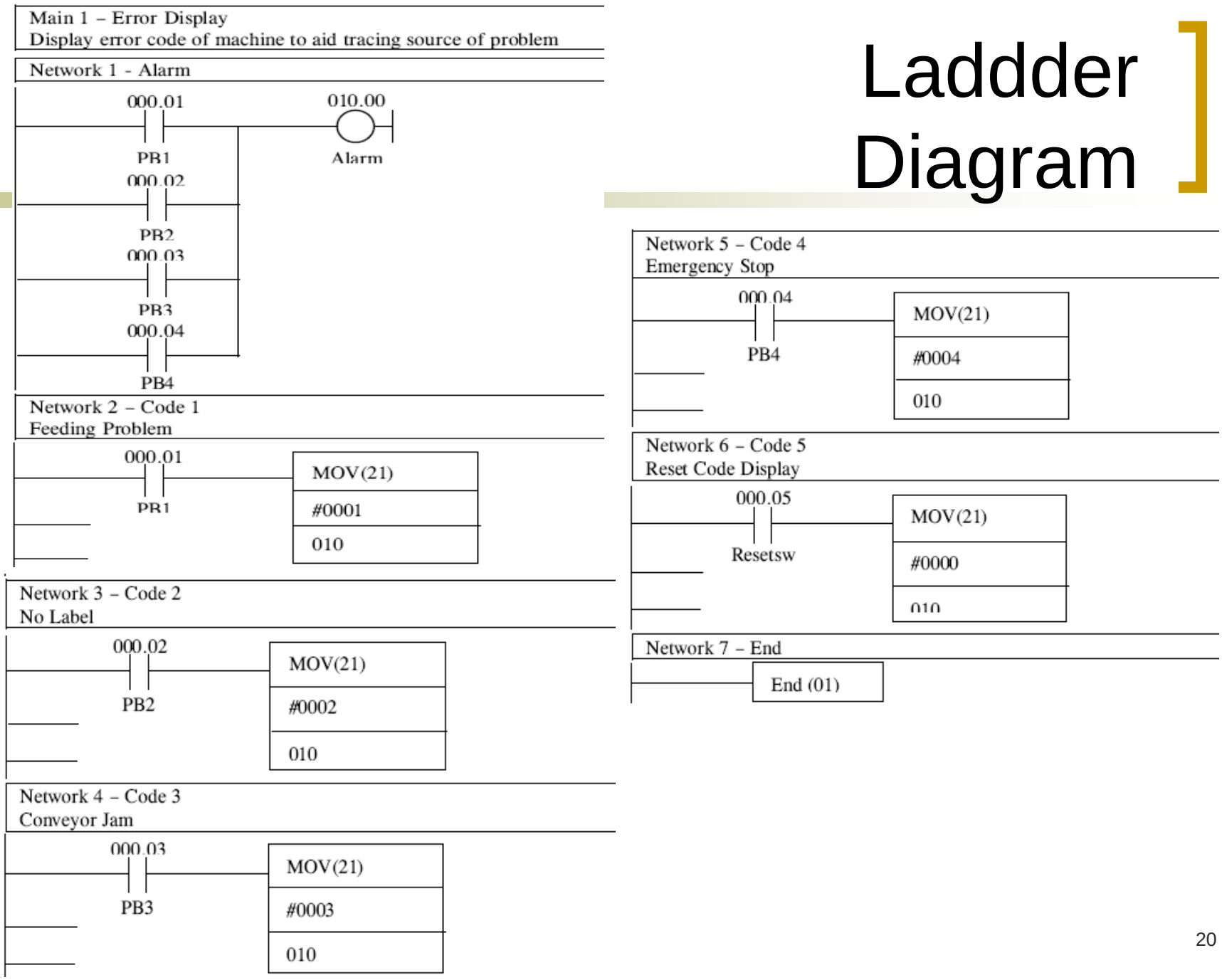
I/O Assignment

Input	Devices
00001	PB1
00002	PB2
00003	PB3
00004	PB4

Output	Devices
1000	Alarm Annunicator



Laddder Diagram

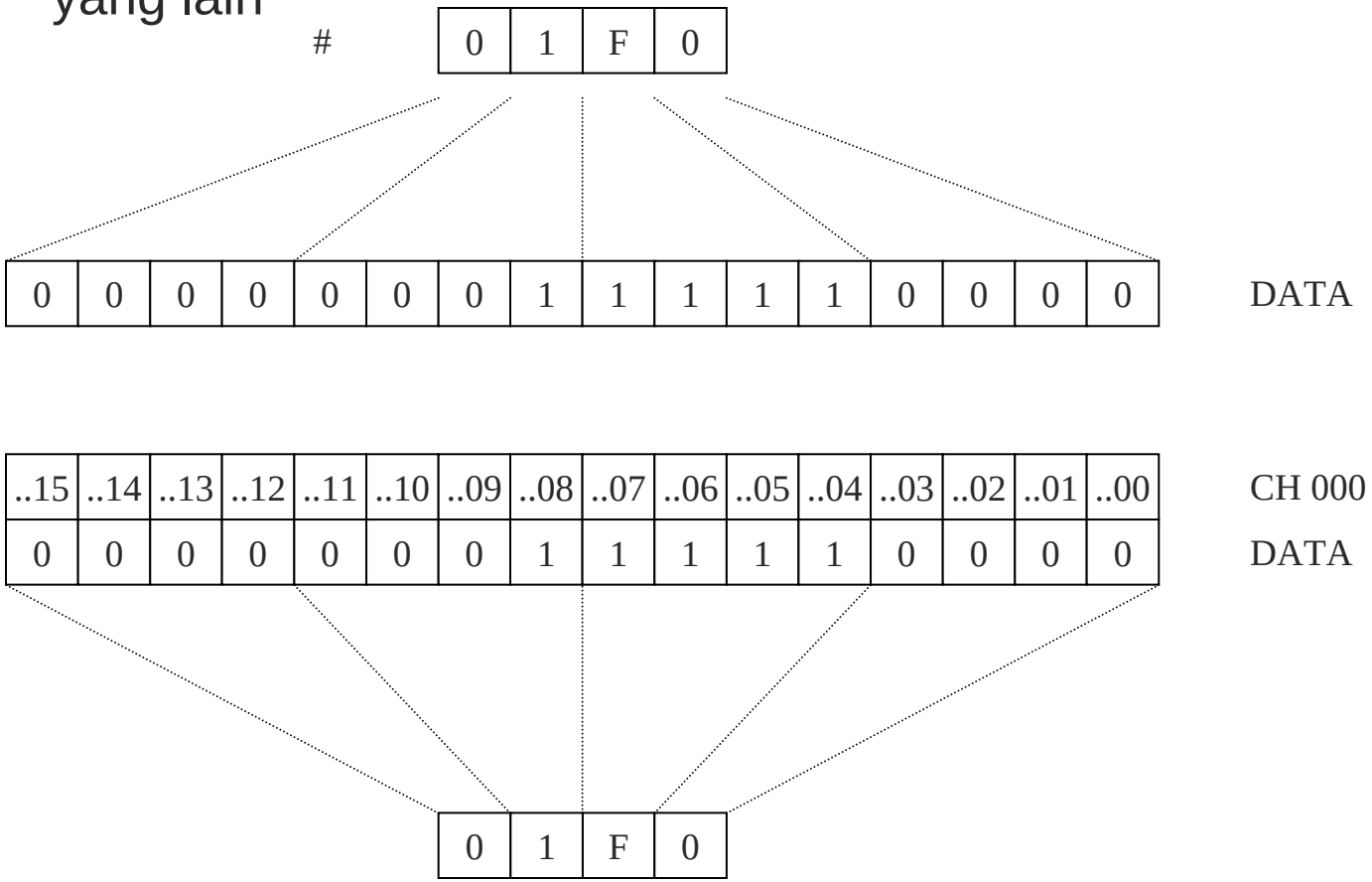


Comparison Instruction

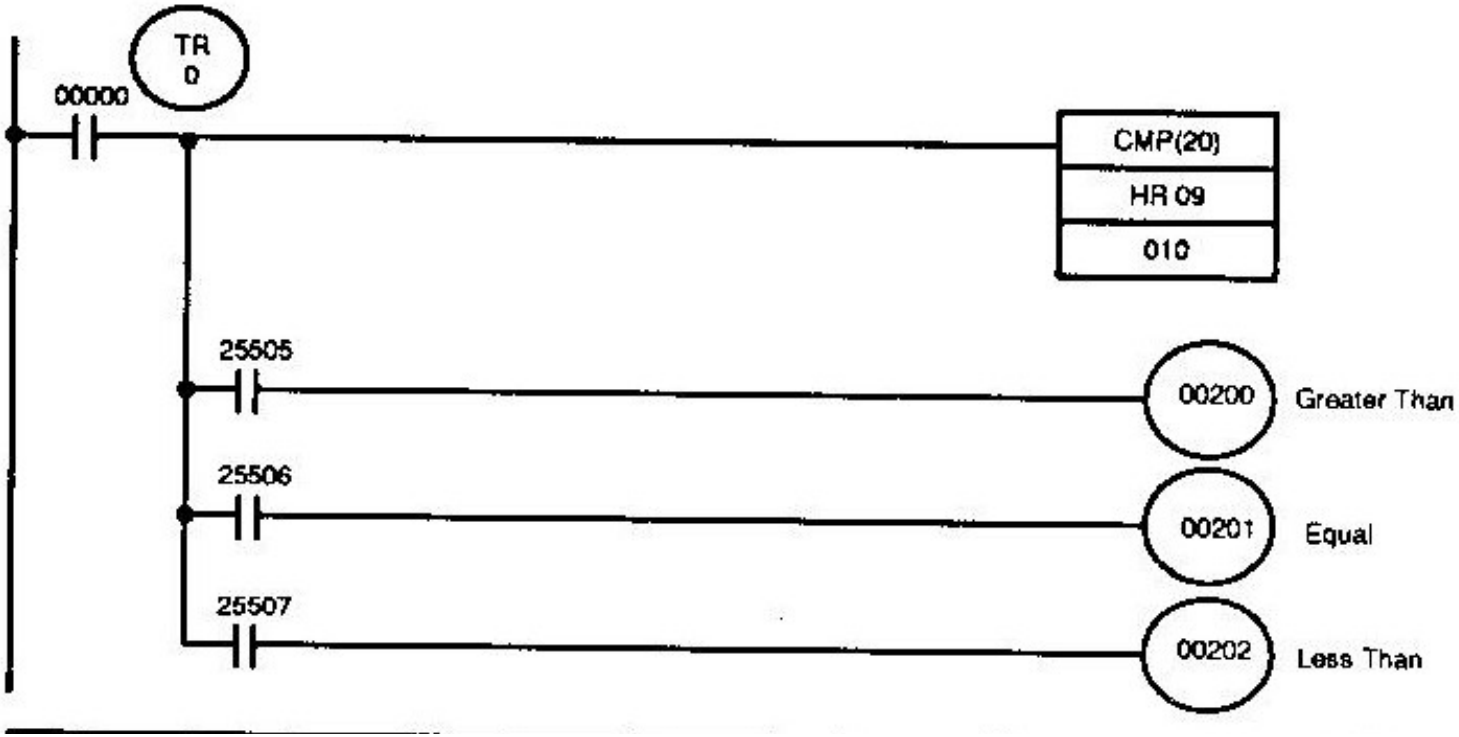
- Untuk melakukan operasi perbandingan :
  - Antar *Word* → COMPARE – CMP(20)
  - Antar *Table* → TABLE COMPARE – TCMP(85)

Comparison Instruction

- CMP (20)
  - Membandingkan data (isi alamat) dengan data (isi alamat) yang lain



Comparison Instruction



Comparison Instruction

- Jika nilai konstanta **=** data *Channel* 000
  - *Special Relay (SR)* 25506 akan ON.
- Jika nilai konstanta **>** data Channel 000
  - SR 25505 akan ON
- Jika nilai konstanta **<** data Channel 000
  - SR 25507 akan ON

BCD Calculation Instruction

- Perhitungan dalam BCD
- Perhitungan dalam Double BCD
- Perhitungan dalam binary
- Contoh operasi :
  - ADD
  - SUBSTRACT
  - MULTIPLY
  - DIVIDE

Calculation Instruction – ADD

- ADD(30)
  - Menjumlahkan data (isi alamat) dengan data (isi alamat) yang lain
  - Sistem bilangan : **BCD**
  - Jika hasil “berlebih”, carry flag (SR 25504) akan menyala

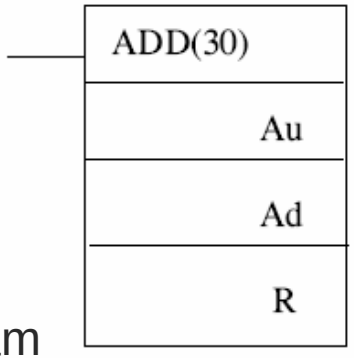
    Au + Ad + CY → CY R

    dimana CY ialah *carry flag*

Calculation Instruction – ADD

Simbol

Ladder Symbols



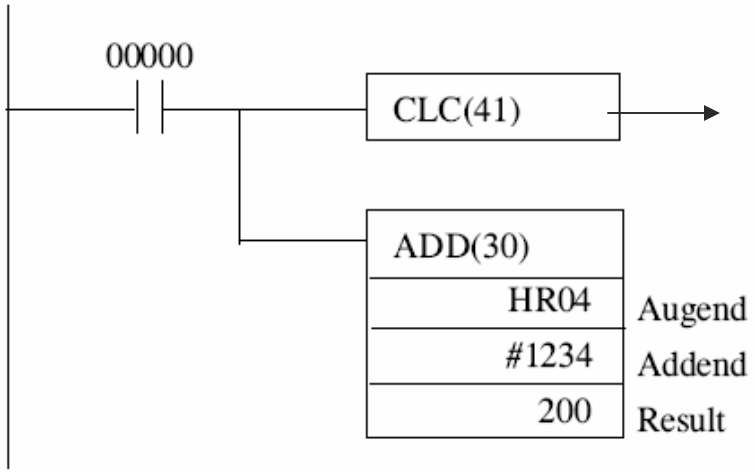
Operand Data Areas

Au: Augend channel
IR, SR, AR, DM, HR, TC, LR, #

Ad: Addend channel
IR, SR, AR, DM, HR, TC, LR, #

R: Result channel
IR, AR, DM, HR, LR

Contoh ladder diagram



Clear carry

Augend

Internal auxiliary relay CH HR04

04000	2^0	10^0
04001	2^1	
04002	2^2	
04003	2^3	
04004	2^0	10^1
04005	2^1	
04006	2^2	
04007	2^3	
04008	2^0	10^2
04009	2^1	
04010	2^2	
04011	2^3	
04012	2^0	10^3
04013	2^1	
04014	2^2	
04015	2^3	

Addend

\+ 1234 +

carry
25504

0

Result

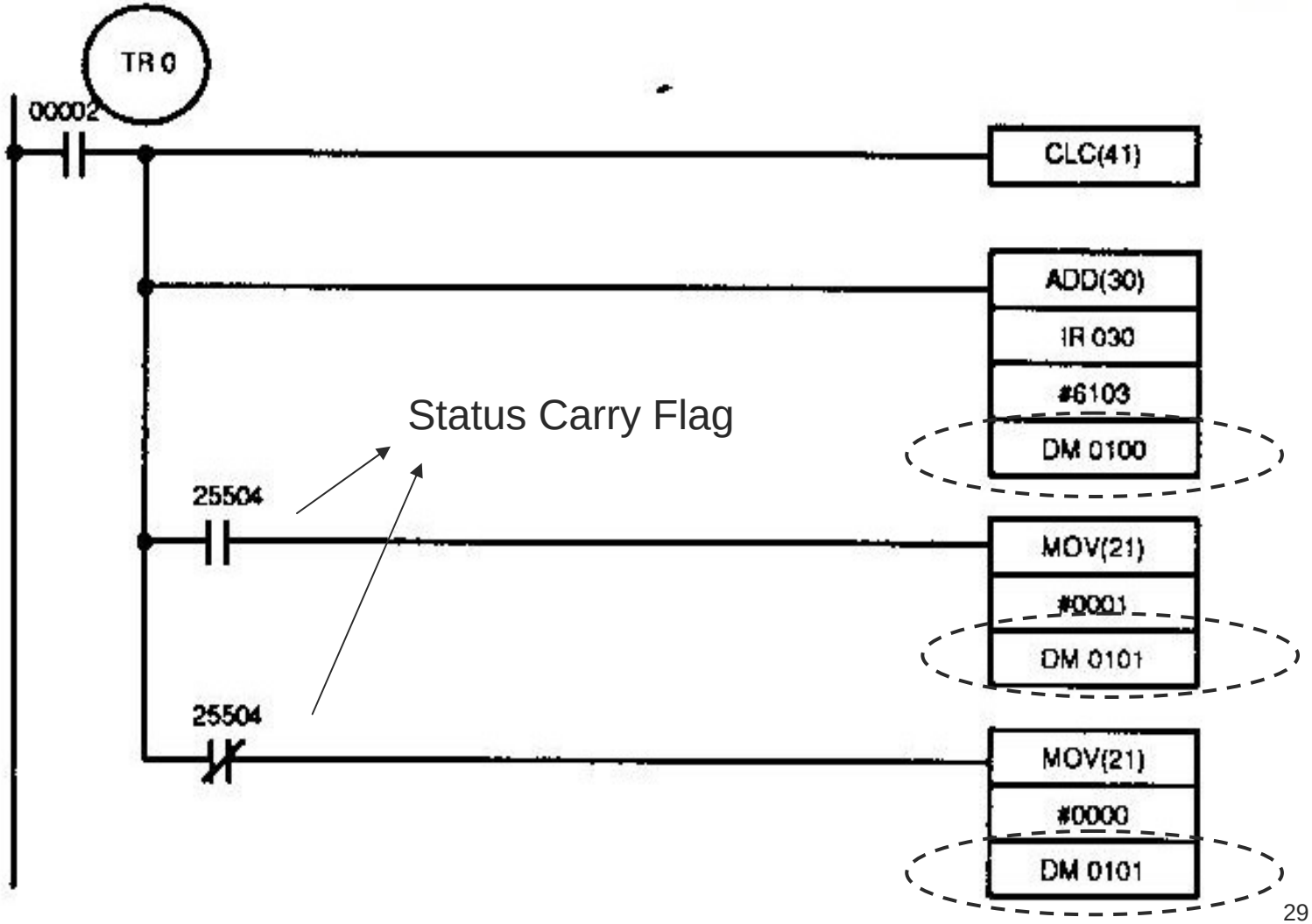
CH 200

10000	2^0	10^0
10001	2^1	
10002	2^2	
10003	2^3	
10004	2^0	10^1
10005	2^1	
10006	2^2	
10007	2^3	
10008	2^0	10^2
10009	2^1	
10010	2^2	
10011	2^3	
10012	2^0	10^3
10013	2^1	
10014	2^2	
10015	2^3	

carry
25504

0/1

Contoh :


TR 0
00002
CLC(41)
ADD(30)
IR 030
#6103
DM 0100
Status Carry Flag
25504
MOV(21)
#0001
DM 0101
25504
MOV(21)
#0000
DM 0101

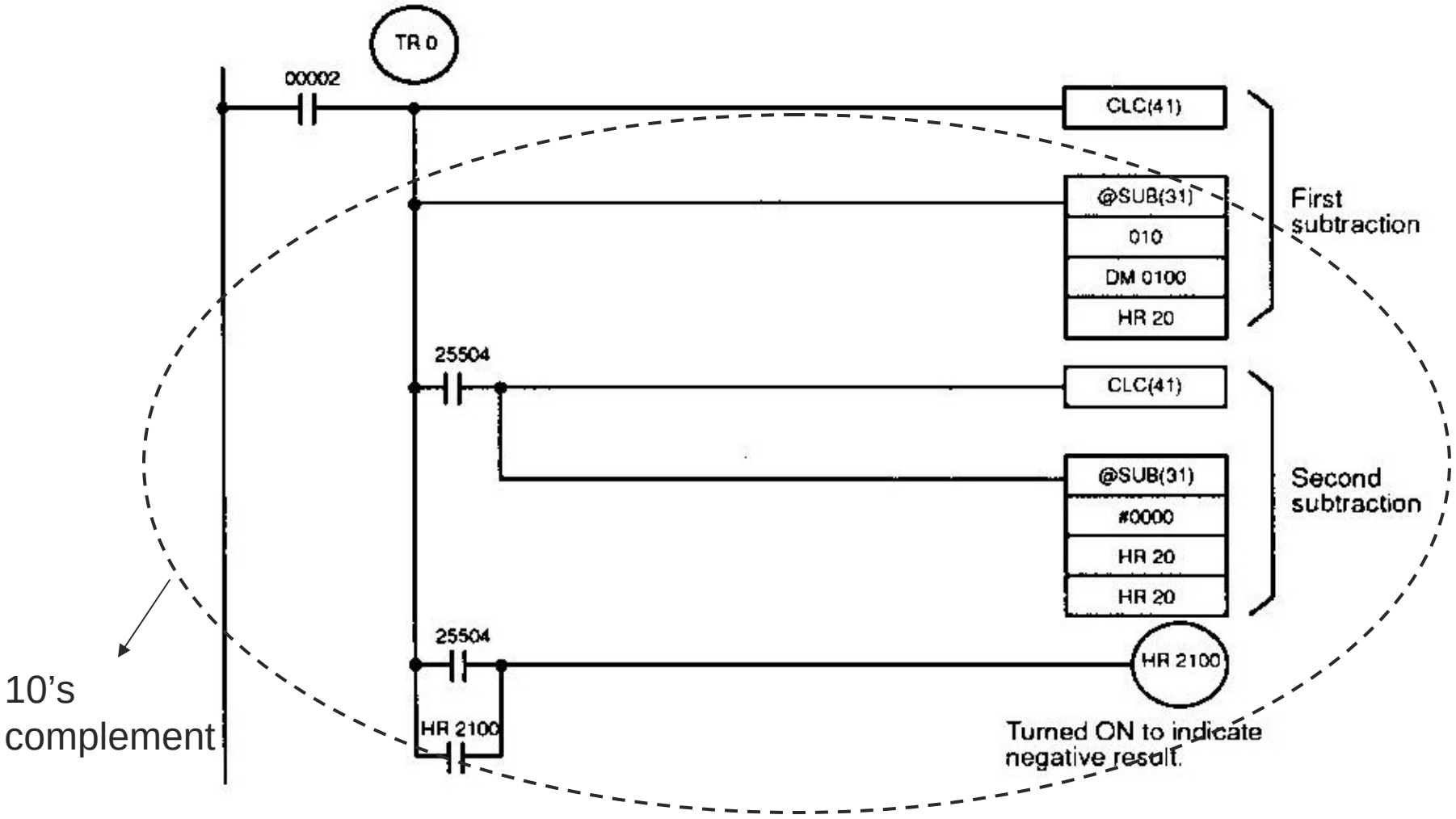
Calculation Instruction – SUB

- SUB(31)
  - Mengurangkan data (isi alamat) dengan data (isi alamat) yang lain
  - Sistem bilangan : BCD

    Mi - Su - CY → CY R

    dimana CY ialah *carry flag*
  - Jika hasilnya negatif, carry flag (SR 25504) akan menyala
  - *10's complement* digunakan untuk negatif

Calculation Instruction – SUB



Calculation Instruction – SUB

- Penanganan bilangan negatif dengan : 10's complement

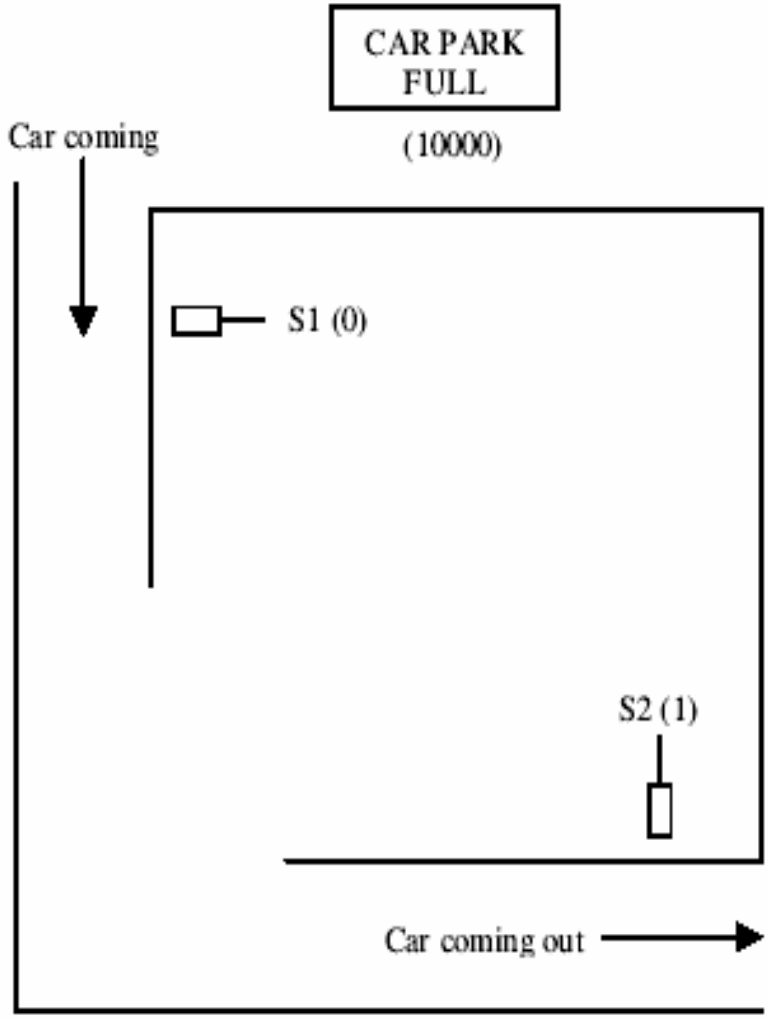
First Subtraction

IR 201	1029
DM 0100	– 3452
CY	– 0 .
HR 10	7577 (1029 + (10000 – 3452))
CY	1 (negative result)

Second Subtraction

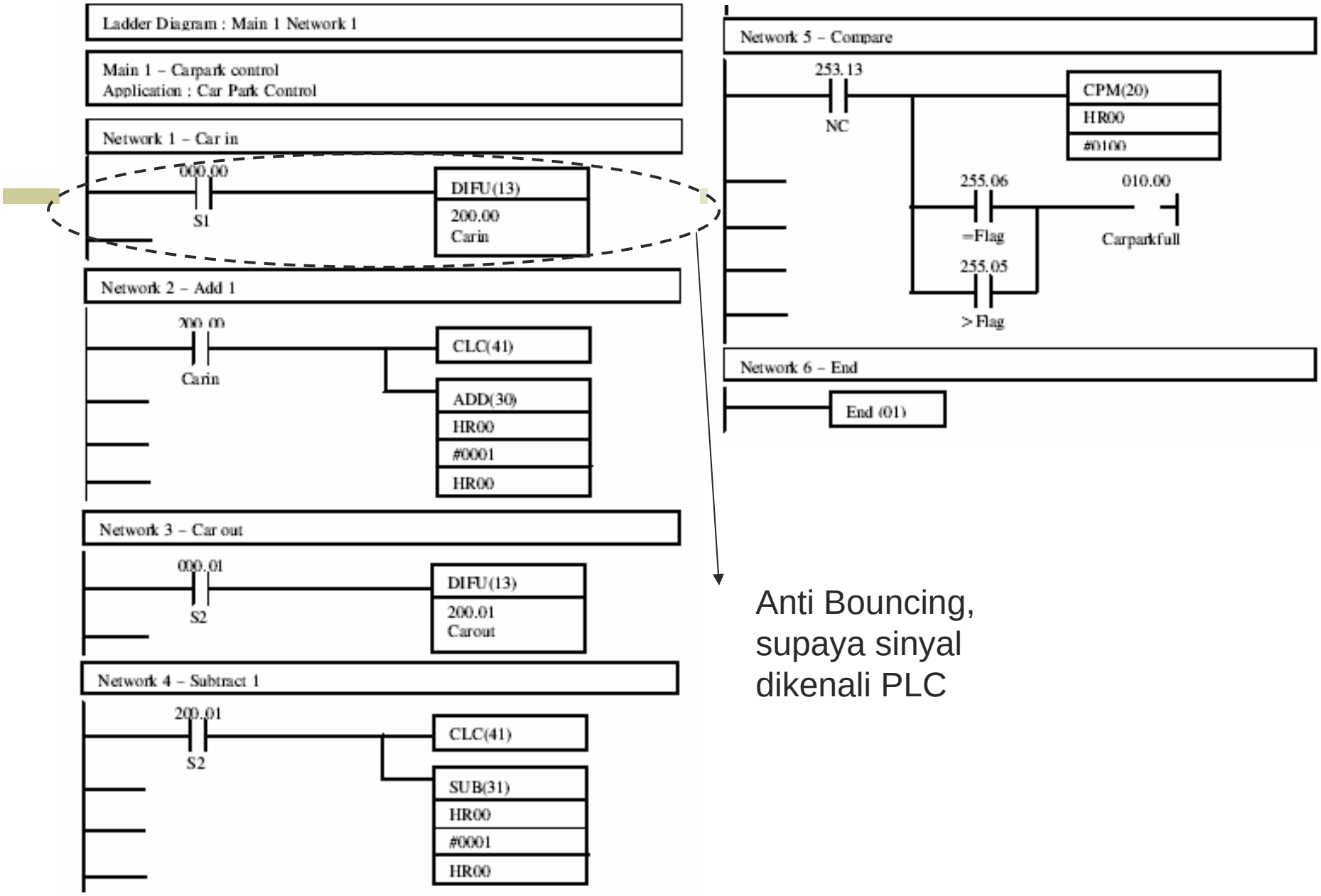
	0000
HR 10	–7577
CY	–0 .
HR 10	2423 (0000 + (10000 – 7577))
CY	1 (negative result)

Contoh Aplikasi – Tempat Parkir Otomatis



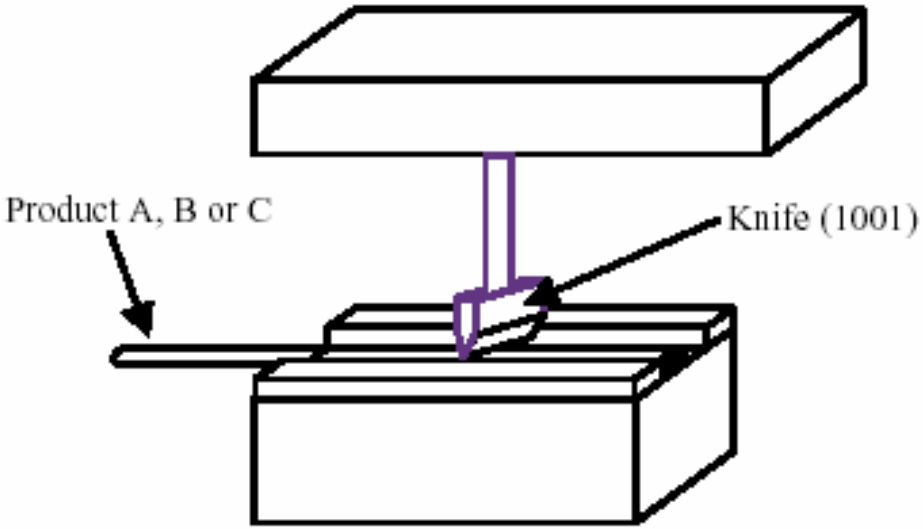
Input	Device
00000	Sensor S1
00001	Sensor S2

Output	Device
01000	Car Park Full Sign



Anti Bouncing, supaya sinyal dikenali PLC

Contoh Aplikasi – Sistem Pemotongan Barang Otomatis



Cutting Machine

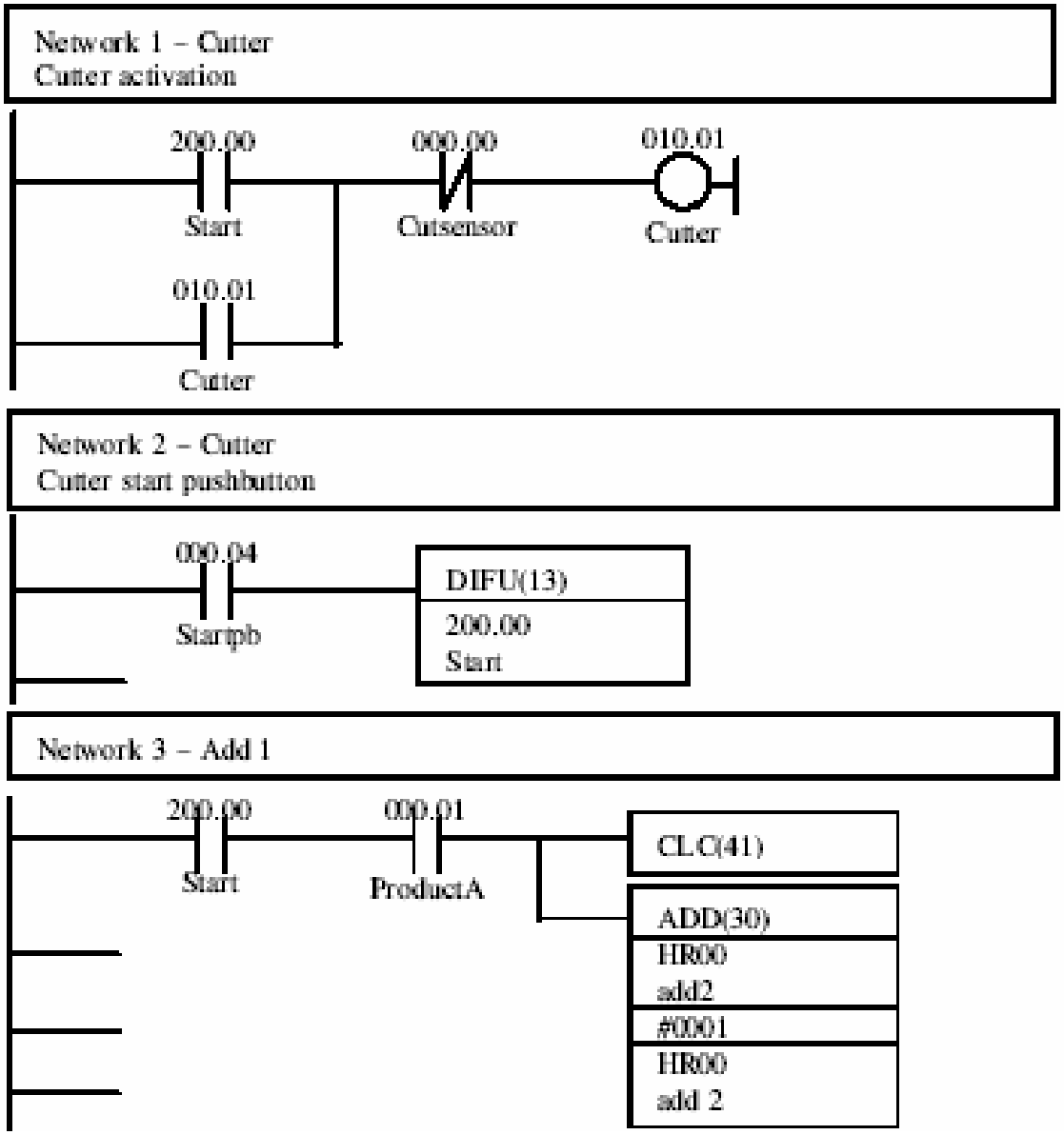

Start Push-button (4)

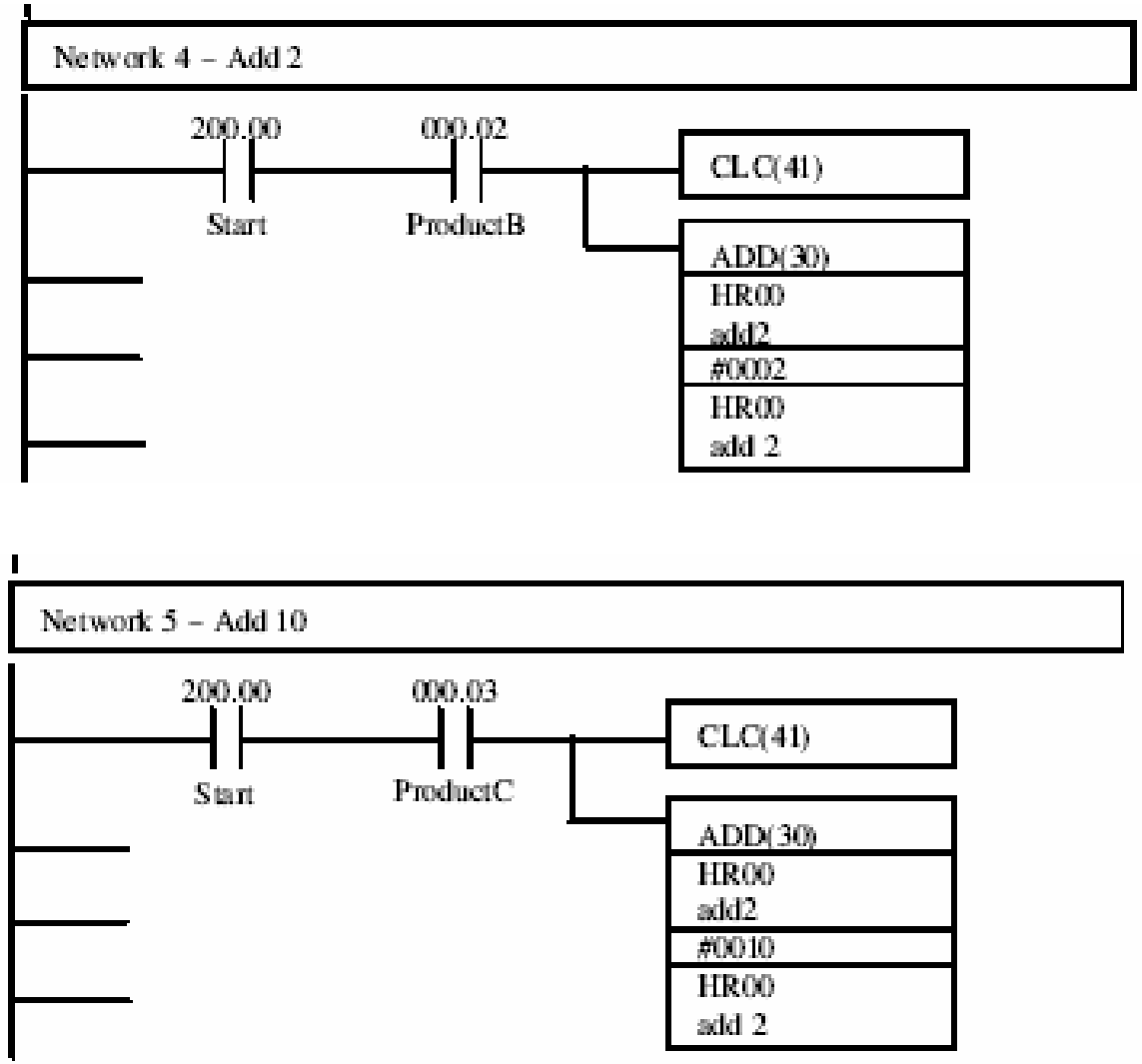

Reset Push-button (5)

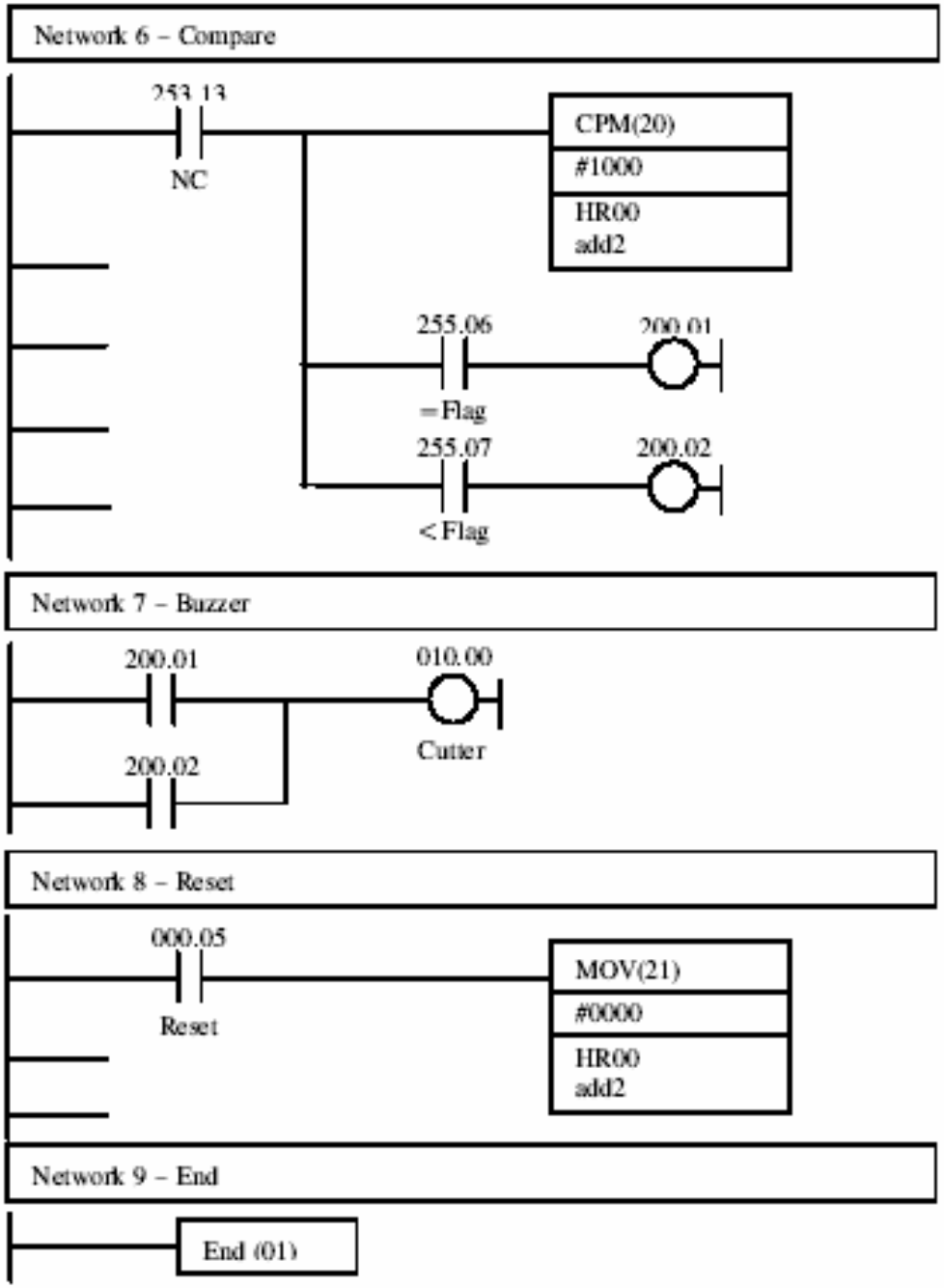

Buzzer (1000)

Output	Device
01000	Buzzer
01001	Cutter (Knife)

Input	Device
00000	Cutter Sensor
00001	Product A
00002	Product B
00003	Product C
00004	Start pushbutton
00005	Reset


Network 1 – Cutter
Cutter activation
200.00
Start
000.00
Cutsensor
010.01
Cutter
010.01
Cutter
Network 2 – Cutter
Cutter start pushbutton
000.04
Startpb
DIFU(13)
200.00
Start
Network 3 – Add 1
200.00
Start
000.01
ProductA
CLC(41)
ADD(30)
HR00
add2
#0001
HR00
add 2


Network 4 – Add 2
200.00
Start
000.02
ProductB
CLC(41)
ADD(30)
HR00
add2
#0002
HR00
add 2
Network 5 – Add 10
200.00
Start
000.03
ProductC
CLC(41)
ADD(30)
HR00
add2
#0010
HR00
add 2

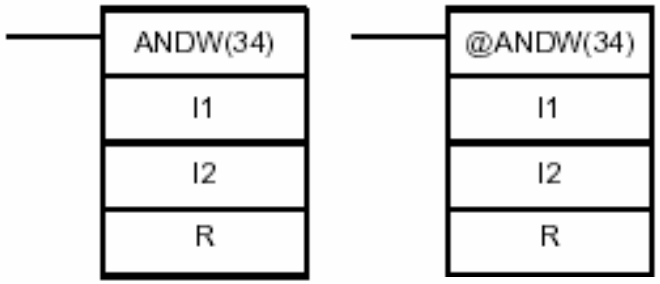

Network 6 – Compare
253.13
NC
CPM(20)
#1000
HR00
add2
255.06
=Flag
200.01
255.07
<Flag
200.02
Network 7 – Buzzer
200.01
200.02
010.00
Cutter
Network 8 – Reset
000.05
Reset
MOV(21)
#0000
HR00
add2
Network 9 – End
End (01)

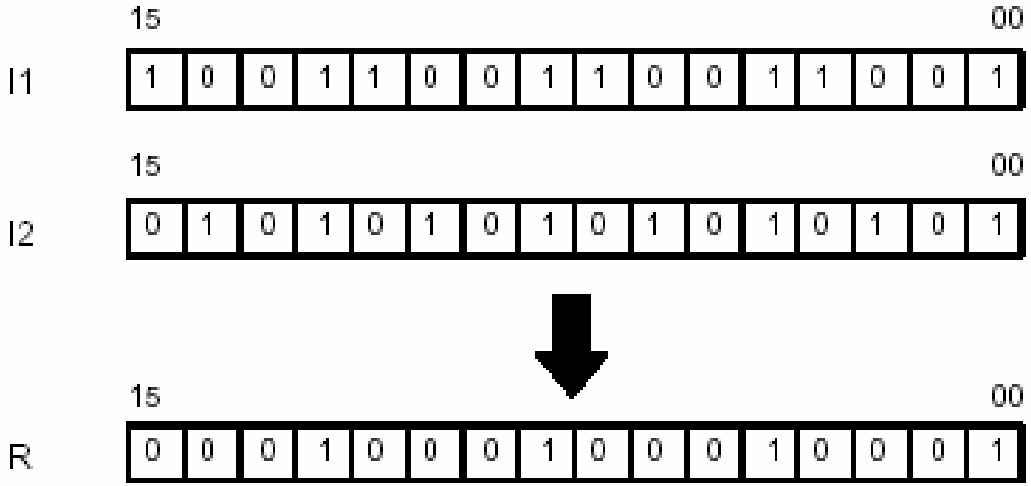
Logic Instruction

- Menjalankan operasi logika untuk 1 *word* sekaligus
- Contoh :
  - NOT
  - AND
  - OR
  - XOR

Logic Instruction - AND

Ladder Symbols



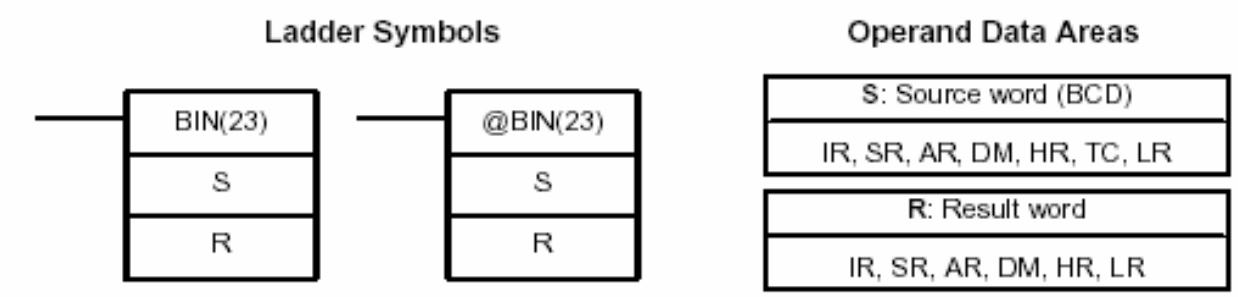


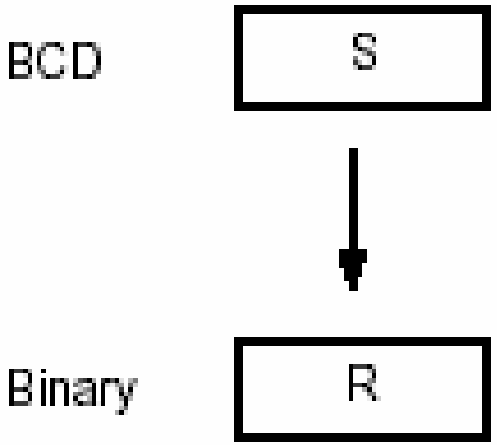
Number system conversion

- Mengubah sistem bilangan
- Contoh :
  - BCD TO BINARY
  - BINARY TO BCD

Number system conversion

- BCD TO BINARY – BIN(23)





Contoh Aplikasi

- Contoh penggunaan BCD to Binary:
  - Jika ingin menggunakan data hasil perhitungan dalam BCD (Add, Sub, …)

    untuk diolah dengan instruksi lain dalam heksadesimal (Move, Compare,…)

    Misal : jika ingin memindahkan hasil perhitungan BCD ke modul analog output