!EMIER INSTRUMENTS & CONTROLS LIMITED

HRD/PROJ/99
March 13, 1999

PROJECT CERTIFICATE

This is to certify that the following **Final BE (EEE)** students of Kumaragu
College of Technology, Coimbatore have carried out a project work in our
organisation:-

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2. **Mr SK Arun**
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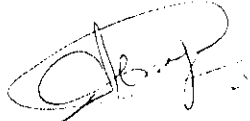4. **Mr R Shanmuga Sundaram**

P-353

Title of the project : *AUTOMATION OF INJECTION MOULDING
MACHINE USING PROGRAMMABLE LOGIC
CONTROLLER*

Period of project : 14.12.1998 To 01.03.1999

Department : Maintenance

During this period, their attendance and conduct were found to be good.

We wish them the very best for a bright future.

ANTHONY THIAGARAJAN
ASST. MANAGER - HRD

ACKNOWLEDGEMENT

We are highly indebted to our Project Guide Mrs. Rani Thottungal, for her unparalleled support and guidance offered in completing the project.

We profusely thank our most revered professor, and Head of the department , Dr. K.A.Palaniswamy, B.E. , M.sc. (Engg.), Ph.D., M.I.S.T.E., C.Engg.(I), F.I.E., Professor and head of the Electrical & Electronics Engineering Department, for his valuable guidance and encouragement throughout the progress in our project.

We also extend our thanks to principal and management for providing us with adequate facilities.

We take pride in expressing our gratitude to Mr.Sivasalapathy , for suggesting the project, Mr.Kalyan Kumar for his patient guidance.

SYNOPSIS

In the fast and advanced scientific world, the basic needs of human life are to be catered efficiently. This necessitates the evolution of new modern methods in manufacturing industry is governed by certain factors such as time, quality, accuracy etc. A small deviation of which might cause economic setback. Maintenance of quality and time is achieved by the process of automation.

For moulding granules of plastics Injection moulding machines are widely used. If facilitates production of quality products of desired shape. In this project it is proposed to automate Injection moulding machine by controlling parameters such as temperature, pressure, number of machine cycles, time taken to complete a machine cycle etc. To achieve this programmable logic controller Man -- Machine interface is used, which make the model very compact.

A software is used to program the Programmable Logic Controller and the same is developed and tested.

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CHAPTER I

INTRODUCTION

1.1 Principle of operation

Injection moulding machines are widely used in industries for fabricating plastics of desired shape. The manual operation involved in the process of plastic moulding shown in (fig 1.1) is described in sequential steps.

a) Feeding the raw material

b) Heating of the shot material

c) Closing the mould

d) Injection the motten plastic

e) Cooling of plastic in the mould

f) Opening the mould

g) Injecting the finished product by air blast

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1.2 Need for automation and advantages.

The manual operation is tedious and results in fatigue of the operator. The existing system offers more drawbacks which opens for automation. The chief advantages of automation are to effectively reduce the man hours and achieve an automated system where manual interference is minimum or nil.
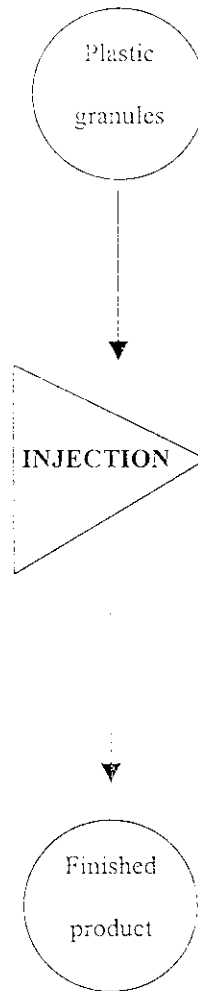
1.3 Existing panel and improvement

The existing panel is very bulky and occupies more space. Due to the presence of mechanical relays etc. The time taken to complete one machine cycle is longer. The machine when operating is also noisy and hence results in operators inconvenience. Ultimately the industrial environment becomes unhealthy. The control equipment now designed chiefly uses programmable logic controller. It is very compact and each parameter is controlled module-wise. The whole control process can be altered by changing the programs in programmable logic controller. Man – Machine interface is used to give the necessary parameter settings.

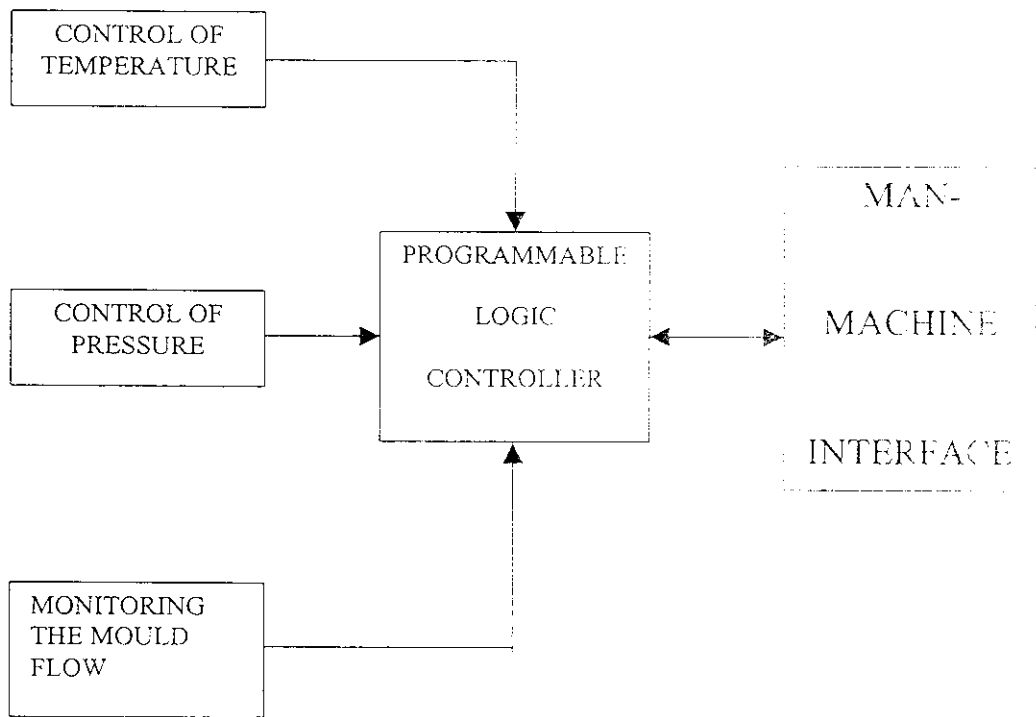## 1.4 Hallmarks of using PLC in control circuit:-

- Pilot running

- Visual observation

- Remarkable speed of operation

- Reliability & Maintainability

- Simplicity of ordering control system components

- Documentation

- Security

- Ease of change of programming

Fig (1.2) shows the logical block diagram of automatic Injection Moulding machine. The details of various blocks are explained in subsequent chapters.

Plastic granules

INJECTION

Finished product

Fig 1.1 PLASTIC MOULDING PROCESS

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CONTROL OF TEMPERATURE	

CONTROL OF PRESSURE	

PROGRAMMABLE

LOGIC

CONTROLLER

MAN-

MACHINE

INTERFACE

MONITORING THE MOULD FLOW	

LOGICAL BLOCK DIAGRAM OF THE
CONTROL CIRCUIT (1.2)

CHAPTER II

DESIGNING THE TEMPERATURE CONTROL

UNIT

2.1 Introduction:-

The shot material fed through the hopper is heated to convert the raw material into the molten form. The temperature has to be maintained at a particular value, beyond or below which the plastic finishing may be deviate from perfection. The temperature in the chambers if exceeds the set value, results in drooling of the molten material. If the temperature is below the set value, the plastic fluid will be unable to move from one chamber to the other.

2.2 Areas of control in temperature:-

The areas where temperature is to be controlled are feed chamber, main chamber. The value of temperature to be maintained is input to the processor of the programmable logic controller using Man – Machine interface.

The temperature is controlled using two types of transducers,

1) Thermocouple

2) Thermister.

2.3 Thermister:-

Thermisters are semiconductor devices whose resistance decrease with increase in temperature. The rise in temperature causes $I^2 R$ losses in the thermister. This hence results in increase in current and decrease in resistance. This property of decrease in resistance with increase in current is known as negative coefficient characteristic. This hence can only indicate rise of temperature above a certain value. Thermister is used to control the temperature of hopper feed.

2.4 Thermocouple :-

Thermocouple is another transducer which converts the junction temperature to corresponding voltage. It essentially consists of a pair of dissimilar conductor welded or fused together at one end to form the hot or measuring junction to the cold or reference junction. A temperature difference must exist for this to act as a thermocouple. Thermocouple is thus used to control temperatures at the chambers.

Thus tabulation shows the conversion of temperature to voltage.

INPUT TEMPERATURE (^{o}c)	OUTPUT VOLTAGE (mv)
30	0
50	1.5
100	3.72
150	6.25
200	9.02
250	11.98

2.5 Temperature control:-

2.5.1 Control using transmiter:-

The temperature at the hopper feed chamber should be maintained at a certain value. The purpose of this check is to avoid rise in temperature of plastic beyond a certain value. which otherwise may result in rise of fluid to the hopper. Water circulates outside this region to avoid very high temperature rise. Lines from thermister is directly given to programmable logic controller as input. Only after checking for the right temperature, the processor initiates next operation.

2.5.2 Control using thermocouple:-

The feed zone heating softens the plastic granules and the main zone heating is done such that drooling does not occur. Reference value is the preset temperature entered through touch sensitive screen. The thermocouples functions to equalize the temperature at the chambers with

preset values. Thermocouple output (mv) is transformed to equivalent voltage (0 – 10 v) using temperature transmitter. This is hence used as signal conditioner. The conditioned signal is given to Analog Digital converter unit the processor receives this digital signal and accordingly alters supply to the heater coils.

Hopper Temperature → | Transmiter | → To PLC

Fig (2.1) CONTROL OF HOPPER TEMPERATURE

Temperature
In feed / main zone
↓

| Thermoco-uple |

↓

| Temperature transmiter |

↓

| A/D converter |

↓

To PLC
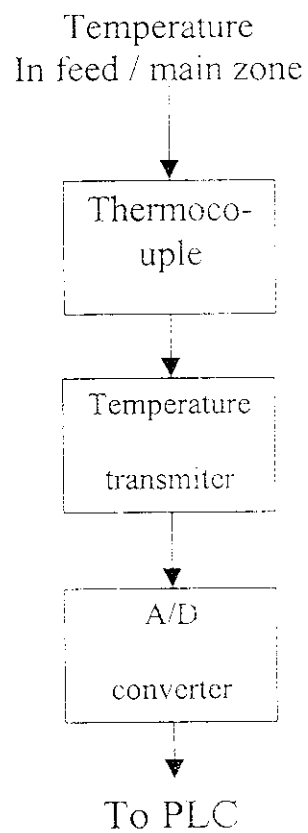
Fig (2.2) CONTROL OF HEATER TEMPERATURE

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CHAPTER III

DESIGNING OF PRESSURE CONTROL SYSTEM

3.1 INTRODUCTION:-

Air pressure is controlled in the injection cylinders. clamping cylinder to maintain the speed of injection and mould close / open. The pressure valves , speed & time are preset by the operator using touch sensitive screen on the control panel. These valves are taken as input to the processor.

3.2 Method of control :-

The preset values of pressure are taken as reference by the processor. The pressure valves are split into two. A minimum lesser pressure of pressure A and the maximum of pressure B is set. The processor sends signal to the Digital – Analog converter. This Analog signal is

given to proportional pressure valves. These valves open accordingly to the signal strength of analog input signal. This phenomenon is split pressure is used to ensure smooth injection mould closing and mould opening.

3.2.1 Pressure control in injection cylinders:-

The total injection time, injection speed are preset by the operator. The injection starts after mould close operation is Complete. The proportional valve opens initially such that the pressure in the injection cylinder becomes equal to pressure B. The whole process takes place within the set injection time. This is accomplished using a timer in the processor and the injection gets completed till the injection timer times out.

3.2.2 Pressure control clamping cylinder:-

The split pressure phenomenon is used in this cylinder also. The mould is gradually moved initially till a position A, preset by the operator. After passing through this position. the mould moves faster and gets clamped tightly. This is done using the clamping cylinder. Thus the mould close open speed and other mould settings are achieved using programmable logic controller.

Pressure settings
From Man-Machine
Interface

```
        ▼
┌─────────────────┐
│  Programmable   │
│  Logic controller │
└─────────────────┘
        │
        ▼
DIGITAL SIGNAL
        │
        ▼
┌─────────────────┐
│      D/A        │
│   converter     │
└─────────────────┘
        │
        ▼
```

To Proportional valve
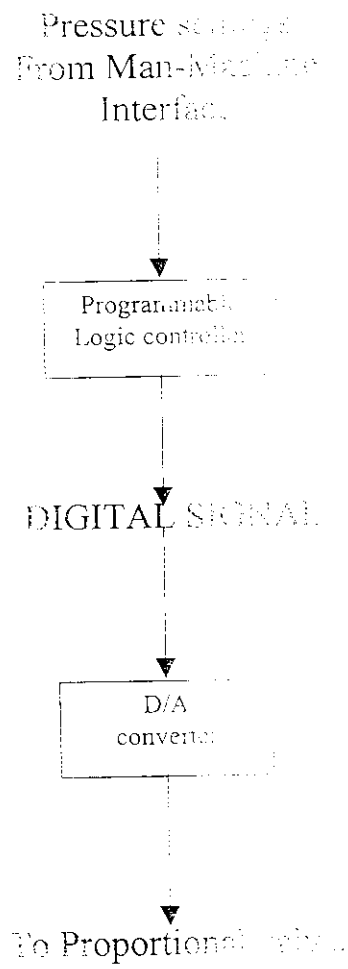
Fig 3.1 PRESSURE CONTROL SYSTEM

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CHAPTER IV

Design of mould flow control system

4.1 Need for mould flow control:-

After feeding the raw material, mould is to be closed. The closing should take place smoothly so that no damage is caused to the mould inside. Mould opens after cooling timer times out. This process of opening has to be smooth to avoid any damage to the finished plastic.

4.2.Principle used in flow control:-

The smooth mould close / open is accomplished using the same split pressure procedure. A position is preset using touch sensitive screen. Till this position, pressure A is maintained. After passing this position, pressure is gradually increased to pressure B. The position assessment is done using opto – sensor. Any obstruction in the mould may cause the mould not to close fully. This causes the machine

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cycle to reset. All the above are done using optical sensors . proximity sensors.

During mould open, the mould needs to jog the number of times as preset by the user. Jog of the mould is used to loosen the finished product from the mould surface.

4.2.1 Opto sensor:-

Opto sensor has a built - in light source. They need not have external source for energisation. When a surface is placed in front of it, the light gets reflected and is absorbed by the sensor, the amount of voltage produced depends on the light that is getting reflected. The intensity depends on the reflecting surface and distance at which surface is placed. This has two reflector sensors. This senses the presence of holes in the rod, which is placed above the sensor. The rod moves along with the piston, when mould opens / closes. The holes in the rod passing within the opto-sensors detecting range, are sensed. Depending on the

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number of holes detected, the mould position is sensed. When 18 holes are passed, it indicate complete mould close. For small number of holes a defect is sensed. This opens the mould and the machine cycle is reset.

The mould opens after the cooling timer times out. The same clamping cylinder is used to open the mould. The speed with which mould opens depends on the pressure in the clamping cylinder.

4.2.2 Proximity sensors :-

Proximity sensors are pilot devices that detects the presence of an object or target without physical contact. This sensor is placed in the rear side of the clamp rod. The sensor gives output voltage when mould senses any malfunctioning. This signal is directly given to the programmable logic controller . The processor senses and triggers the next operation when this signal is sensed, the machine cycle is reset.

4.2.3 Jog count:-

Jog count as explained earlier is set using touch sensitive screen. A counter is activated by the processor during mould open and the mould halves jogs for the set number of times. After this counter is completed, air is blasted and the finished plastic product is ejected. This counter is reset for the machine cycle operation.

CHAPTER V

Man – Machine Interface

5.1 Introduction :-

An input terminal is an indispensable component in this control system. A touch sensitive screen is used for entering data in the programmable logic controller. The equipment is designed such that a set of preset values are entered through the Man – Machine Interface. These pre-set values are used as references by the programmable logic controller while production runs. Real time settings can also be done.

The programmable logic controller monitors certain functions of the machine cycle and reports some of the common error emountered during production, by displaying messages on touch sensitive screen.

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5.2 Working of Man –Machine Interface:-

The Man – Machine Interface is basically menu driven. The various menus are displayed on the screen for setting parameters by the operator. Initially a main menu is displayed which gives the following options for pre-setting the parameters

5.2.1 Closing of the mould :-

The first speed at which the mould closes, the position at which the speed is expected to change and the second speed are entered in this menu.

5.2.2 Injection:-

The total injection time, the initial pressure P1, the time till which this pressure is maintained, the final pressure P2 are preset using the cycle settings injection menu.

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5.2.3 Heating:-

This allows the operator to set the temperatures for main, feed, tip and boost heaters

5.2.4 Cooling:-

The total cooling time is set for the cooling of plastic in the mould. This is entered into the touch screen through cycle settings cooling menu.

5.2.5 Opening:-

The opening speeds (A & B), the position of change in speed, similar to close settings are entered.

5.2.6 Ejecting:-

The ejecting time is set. The number of jogs and the jog time are also entered in the menu cycle settings ejection.

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CHAPTER VI

Programmable logic controller

6.1 Introduction

Programmable logic controller is a special device used in industrial machines. It is exclusively designed to operate in industrial environment. There are special I / O modules and a control programming language is used to program the processor.

6.2. Basic parts of PLC

The chief four blocks of programmable logic controller are :

6.2.1 Central processing unit:-

It has a processor which carries out all logical operations. In Memory information (or) program is stored, manipulated and remembered. The power supply converts line voltage ac to operational dc values, regulated and purified.

6.2.2 Programmer monitor :-

Programmer monitor is used to enter programs into the programmable logic controller. The typed information is displayed on the screen.

6.2.3 Input / Output modules:-

The electrical signals of outside processes like push buttons, MMI inputs etc, are given to the input modules. The signals to outside outputs such as coils, conductors, relays etc. are given from the output modules of the programmable logic controller.

6.2.4 Racks and chasis:-

The programmable logic controller is mounted on racks. Chassis encloses the central processing unit, processor memory, I/O modules. The details are shown in fig (6.1).

6.3 Basic operation of PLC:-

The programs consisting of ladder diagrams are entered into the memory Basic logic of the operation denotes the control of machine operation.

6.3.1 Addressing of Inputs , Outputs :-

Inputs are given through the I/O modules to the programmable logic controller. Each input is assigned a specific address. The outputs are connected through output modules. The output signal is sent to the corresponding outputs using specific addresses.

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6.3.2 Memory of the processor:-

The user program is stored in the memory. The input and output Status is stored in the memory as I/O image table for any change is I/O status the image table is correspondingly updated.

6.3.3 Scanning :-

Scanning is the process of continuous and sequential reading of status of input, evaluation of the control logic updation of output. This is shown in fig (6.2).

6.4 Importance of PLC in industrial process control

The most commonly used process control devices are relays , coils, contacts, timers, etc. The electro mechanical relays and timer circuits are easily dispensed with while using programmable logic controllers in industrial process control.

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The various push buttons, switches etc are hardwired to the PLC and assigned addresses. The relay logic is constructed in the form of ladder diagram which is similar to the actual connection of the circuit components. When he machine cycle is started, PLC works as explained earlier and the corresponding output devices are energized. The desired operation is done.

6.4.1 An example :-

Motor should run when pressure end temperature reach their preset values. The pressure and temperature switches close, after the condition is satisfied. This enables the motor to run. If manual operation is opted, the motor runs when 003 closes. Thus the connection of these switches is dispensed with by entering the relay logic diagram in programmable logic controller. However the addresses of the corresponding I/O's should be given clearly in the ladder logic diagram. The ladder logic is shown in fig (6.3)

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6.5 Details of PLC used

6.5.1 Name KV series

16 I / O ports with expandable facilities.

6.5.2 Software package

Incrediware easily loaded in desktop PC and programmed. The other useful features are attached in the appendix.

COILS CONTACTOR
RELAYS etc.,

OUTPUT
MODULE

PROCESSOR

MEMORY

POWER SUPPLY

C

P

U

PROGRAMMER
MONITOR

PARTS OF PLC

INPUT
MODULE

PUSH BUTTONS, LIMIT
SWITCHES ETC.,

RUN PROGRAM

READ INPUTS

ADJUST OUTPUTS
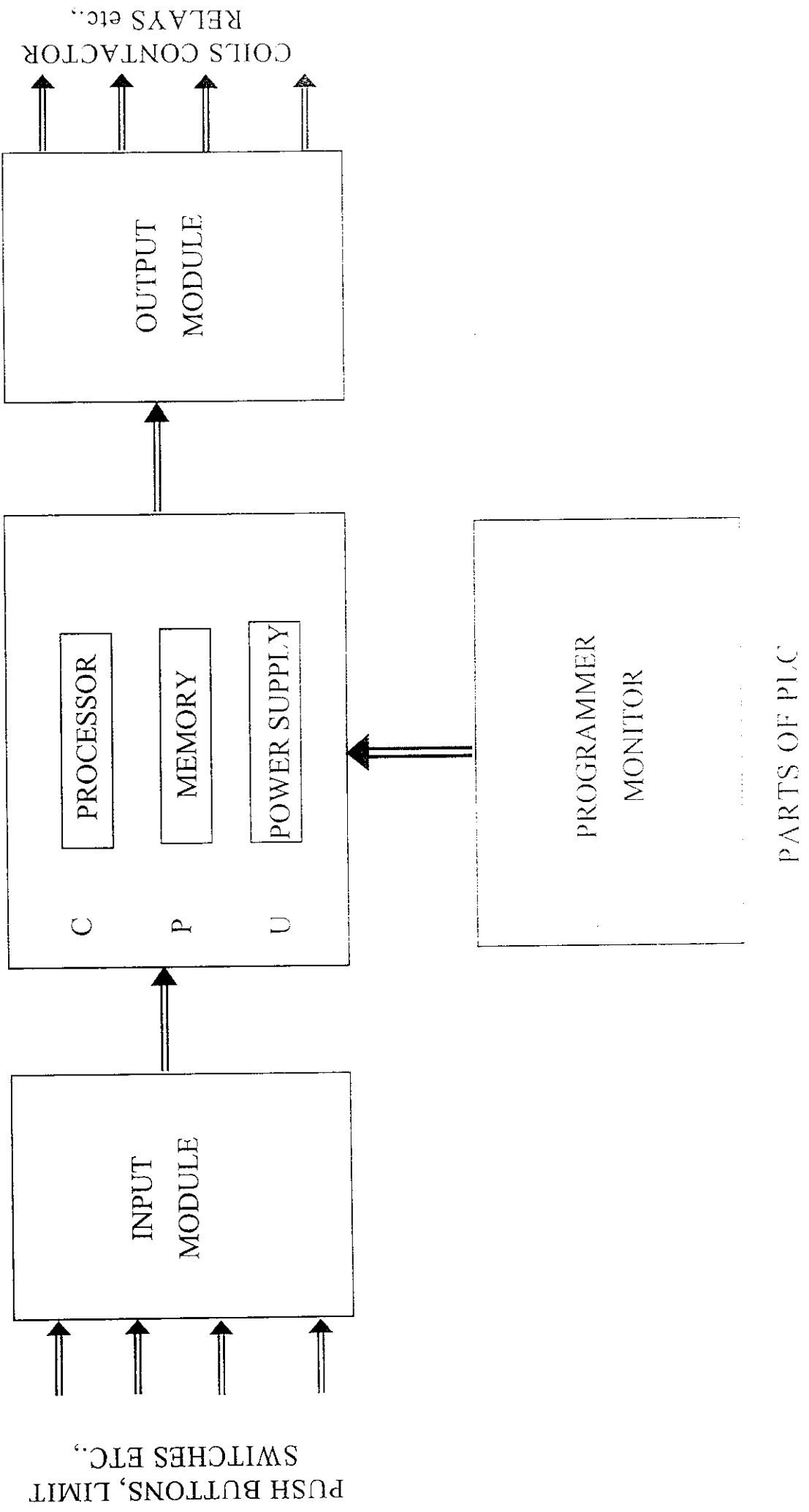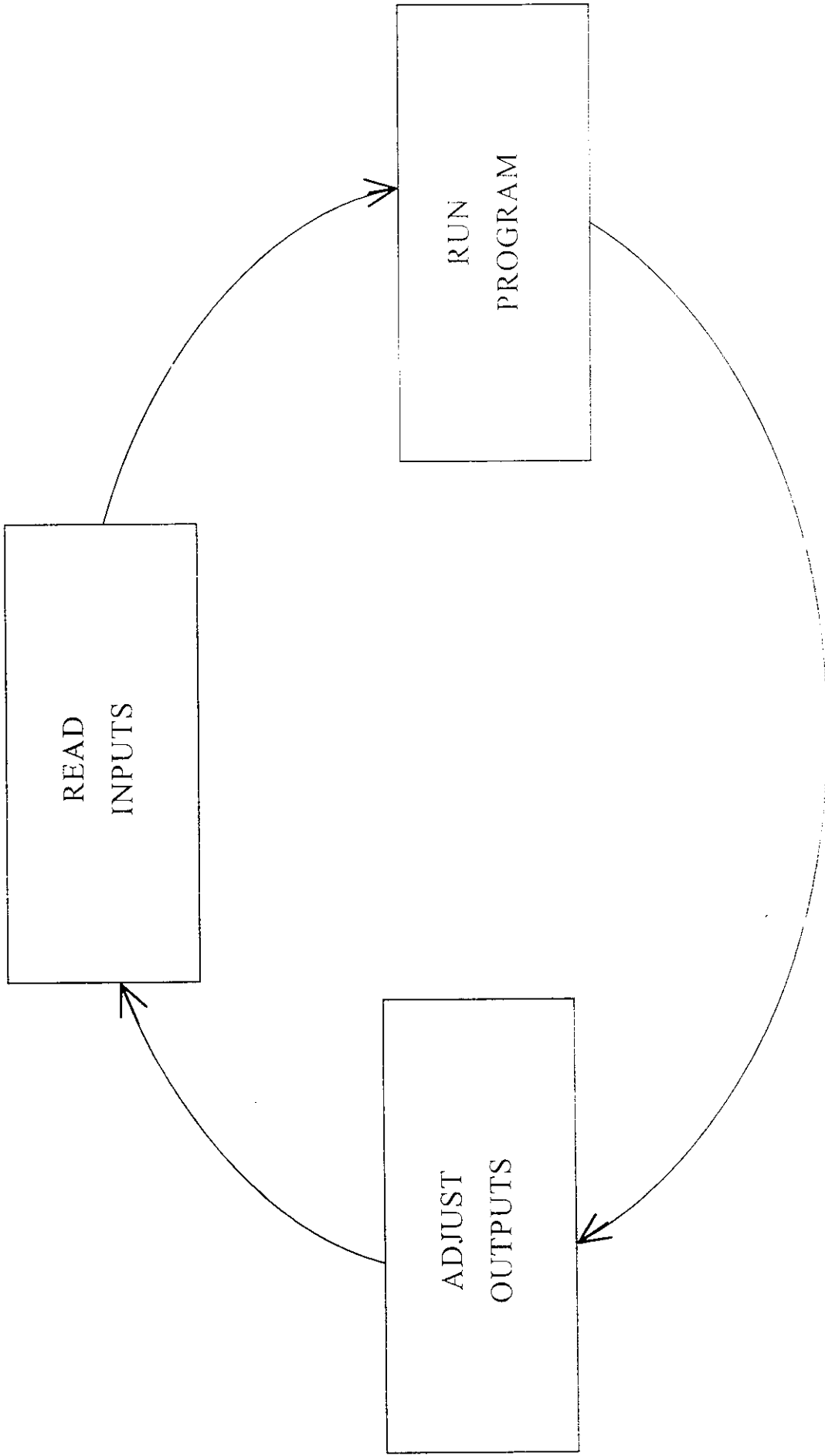
Fig 6.2 ONE MACHINE CYCLE OR ONE SCAN OF PLC

PRESSURE
001

TEMPERATURE
002

003

MANUAL

I/P MODULE

PR   TEMP

001   002

          003

          MAN

M

OUTPUT
MODULE
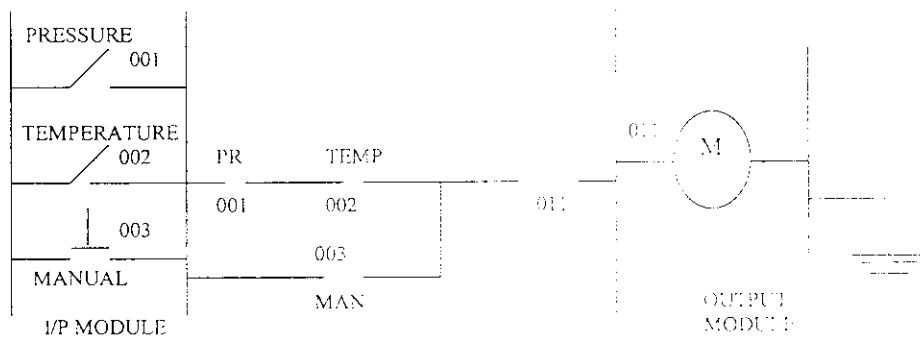
Fig (6.3) CONTROL LOGIC

CHAPTER VII

FABRICATION , INSTALLATION AND

TESTING

7.1 Fabrication:-

The circuit layout is drawn and the component is assembled. The components to the assembled include

a) Programmable logic controller

b) A/D , D/A converters

c) Temperature transmitters

d) Man-Machine Interface

e) Power supply unit

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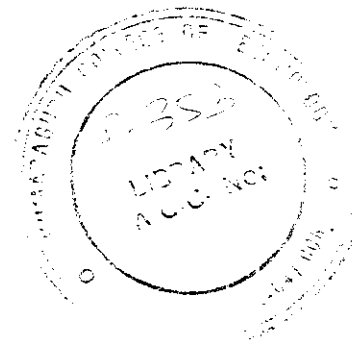
Sensors are fitted at the specified points in the machine. Thus the layout is installed. KV – ladder program is loaded into the processor & the circuit is ready for testing. The fig (7.1 & 7.2 , give the arrangement of the above blocks in the control panel)

7.2 Logical Operation of Automated Injection Moulding Machine

7.2.1 Start the machine cycle:-

The shot material moves from the feed hopper to the main chamber.

Factors to be true :-

a) Operators gate closed

b) Chambers reaching the set temperature

c) Start push button depressed

d) Hopper front sensor gives output.

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7.2.2 Mould close:-

The pressure transmitter opens valve and lets the pressure in the clamp cylinder to the set valve. Mould closes in the speed set by the operator using touches sensitive screen. Any fault in mould closing is sensed by the Opto sense , the mould opens & the cycle restarts.

7.2.3 Injection:-

The position of the injection cylinders moves according to the speed & pressure preset due to controlled output from the pressure proportional valves.

Factor to be true

Opto sensor gives signal to the processor after full mould close.

7.2.4 Cooling

The timer is set in programmable logic controller. The plastic inside is cooled till this timer times out. Cooling time is also preset by the operator.

7.2.5 Mould open & Injection

The mould opens in set speed similar to mould close. Air is blasted by air blast cylinder and the plastic shot is ejected after a set number of Jogs.

7.2.6 Constraint to be considered for all processes

a) Reset push button starts the machine cycle from first

b) Emergency off brings the machine to a grinding halt.

7.3 TESTIG OF THE CONTROL EQUIPMENT

The number of job cycles, temperatures at the chambers Closing and opening cycles, ejection, costing and Injection cycles are set initially. The start push button is depressed and the machine cycle is started. The following fault if occurs, the corresponding error message are displayed.

7.3.1 EMERGENCY STOP

Indicates that the emergency stop push button has been operated and not been released.

7.3.2 GUARD OPEN

Indicates that the front guard has been left open.

7.3.3. HOPPER FAULT

Indicates that the hopper has not been correctly positioned (or) an open circuit exists.

7.3.4. MOULD SENSE

Indicates that an obstruction has caused the mould to stop during the open of close cycle.

7.3.5. OPTO COUNT ALARM

Indicates that fault in position monitoring system.
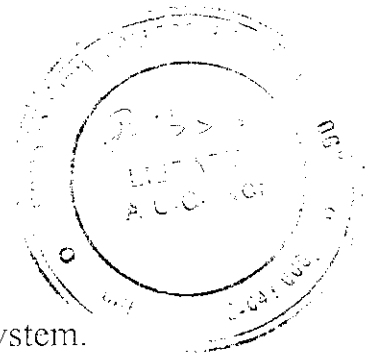
7.3.6 HOPPER OVER TEMPERATURE

Senses if the hopper block has risen over a certain temperature.

7.3.7 TEMPERATURE ALARM

Indicate if main / feed chambers are above / below the set temperature for a single trial, no fault messages were displayed. the machine production was successful.

```
┌─────────────────────────┐              ┌──────────────┐
│                         │              │   MAN        │
│     PROGRAMMABLE        │ ═══════════> │   MACHINE    │
│   LOGIC CONTROLLER      │ <═══════════ │   INTERPACE  │
│                         │              │              │
└─────────────────────────┘              └──────────────┘
        ▲           │
        │           ▼
┌──────────────┐  ┌──────────────┐
│              │  │              │
│    A/D       │  │    D/A       │
│  CONVERTER   │  │  CONVERTER   │
│              │  │              │
└──────────────┘  └──────────────┘
   ▲      ▲              │
   │      │              ▼
┌──────┐ ┌──────┐    To pressure proportional valves
│TEMP. │ │TEMP. │
│TRANS-│ │TRANS-│
│MITTER│ │MITTER│
└──────┘ └──────┘
   ▲        ▲

From Thermocouples
```

Fig (7.1) Block Diagram

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POWER SUPPLY CIRCUIT

Fig.(7.2)

39

RW

N1

CO .7 AP 6. WX9 AP

4 C1 . 7 4 6.
1 1
5 5
VO .8 0 5. WX90 0

V1 . 8 5.

WX10

WX10

.9 4. FROM .9 4.
THERMO
COUPLE

.10 3. .10 3.

.11 2. .11 2.

.12 1. .12 1.
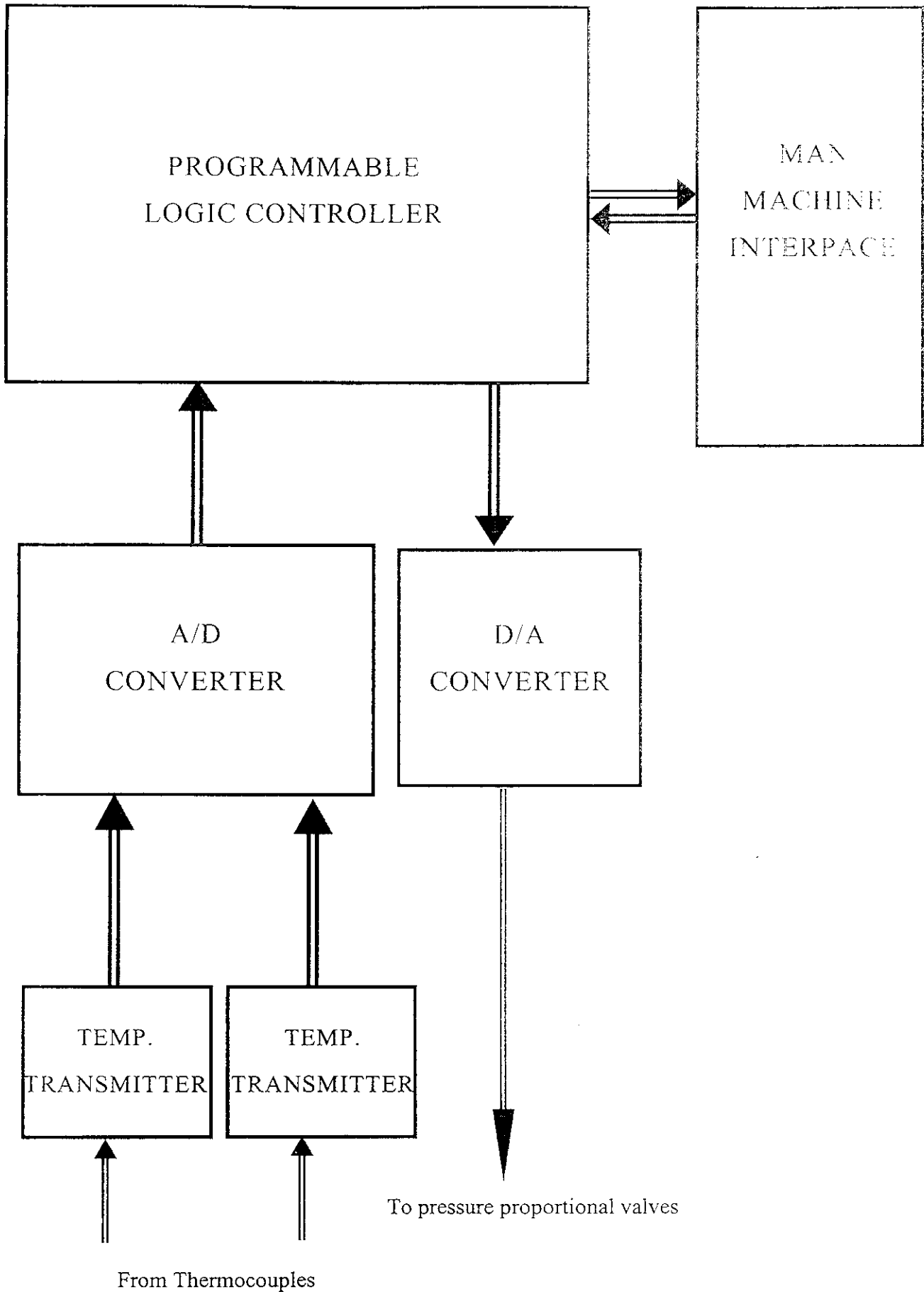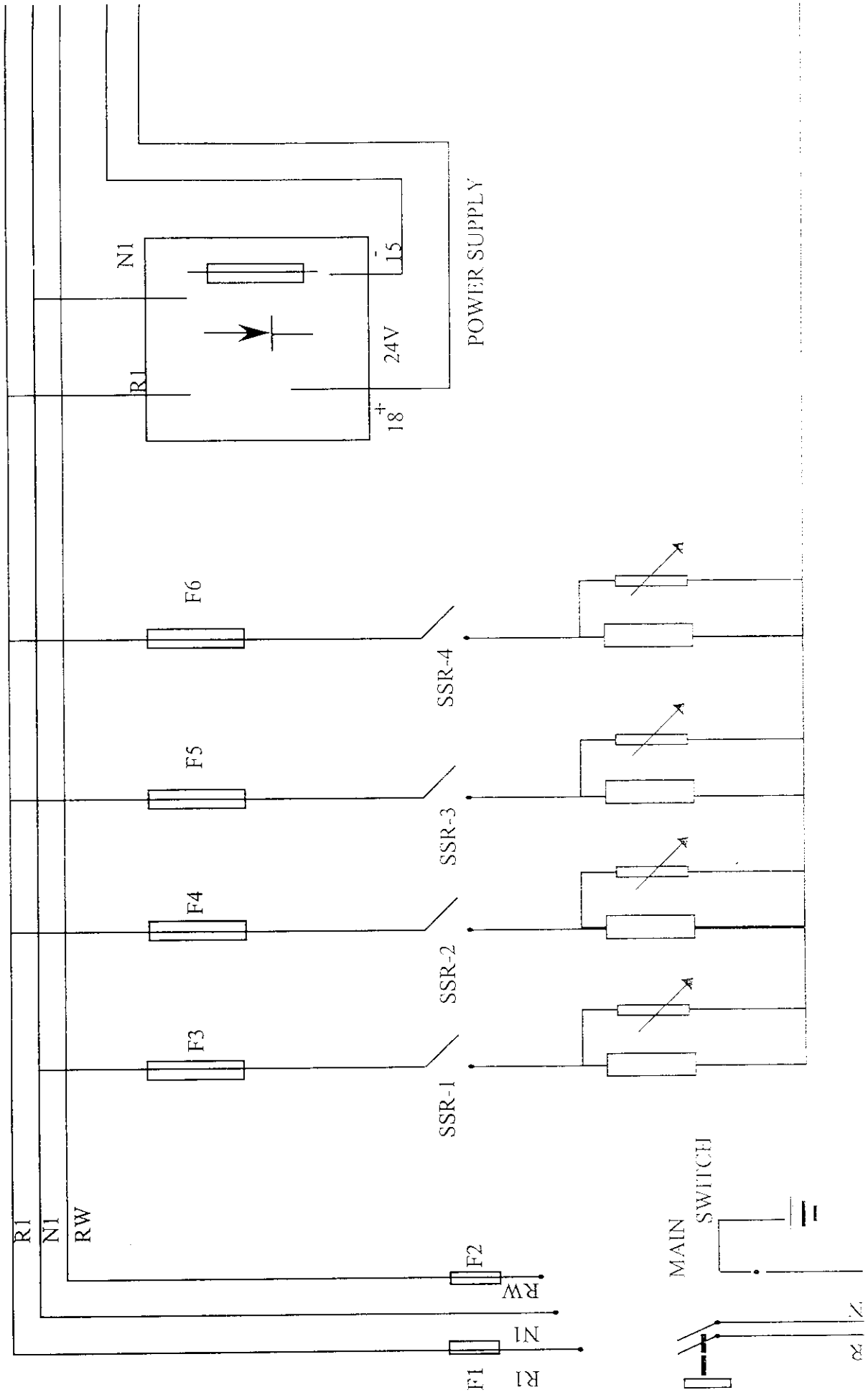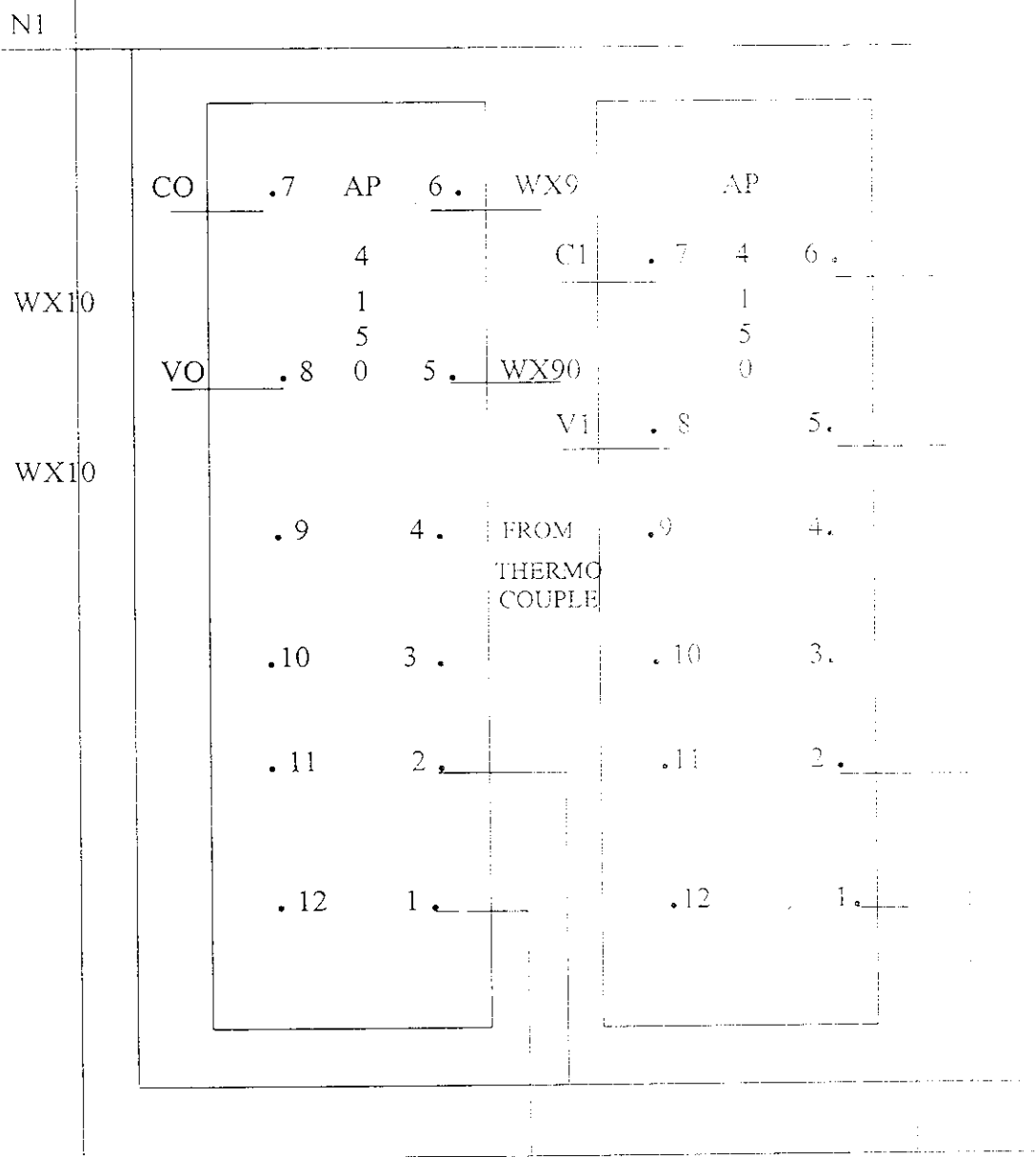
Fig (7.3) TEMPERATURE TRANSMITER

40

Fig (7.4) A/D , D/A CONVERTER

41

RW
N1
18 +
15 -

PLC

24 V
C

XO   OPTO

X1 REAR DOOR
    OPEN
X2   RESET P.B

X3 HOPPER FRONT
  X4
    REAR SENSE
  X5
  EMERGENCY OFF
X6

  DOOR CLOSE
X7

HOPPER TEMP

X0
X1
X2
X3
X4
X5
X6
X7

RW
N1
E
C
Yo

Y1
Y2

Y3
Y4

Y5

Y6

Y7

SOLENOID
COILS

CLOSE   S1
INJECT   S2

EJECT   S3
MAIN

FEED

BOOST
          TIP

RELAY

SSR1

SSR2

SSR3

SSR4

Fig (7.5) PROGRAMMABLE LOGIC CONTROLLER

42

230 V AC

24 V DC

Rectifier

TOUCH
SCREEN

RN | N1 | 18+ | 15 -
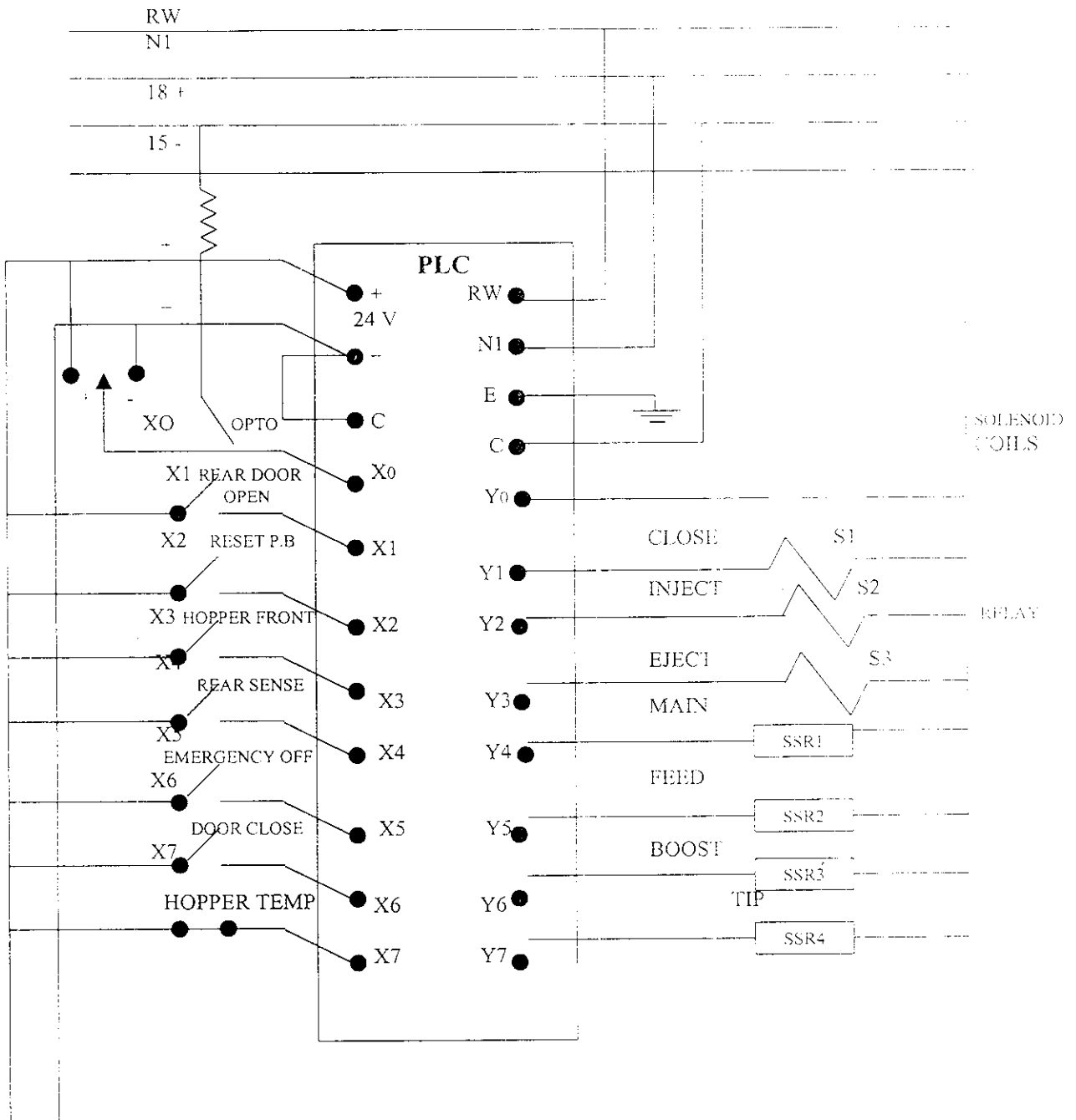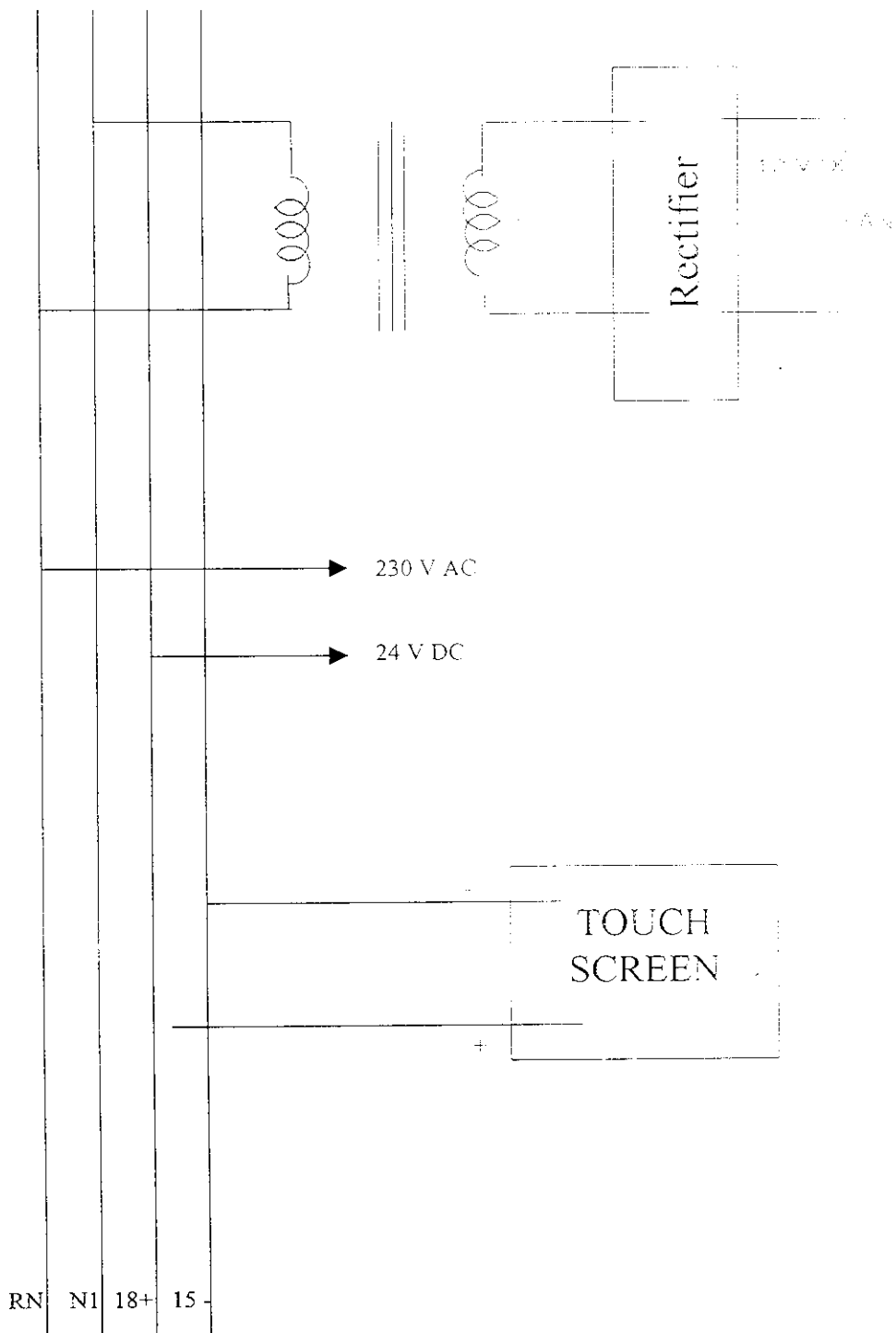
Fig (7.6) RECTIFIER AND SUPPLY TO MMI

CHAPTER VIII

CONCLUSION

"A Keyence KV –series programmable logic controller"
has been programmed and interfaced for automating Injection
Moulding Machine. The automated injection moulding
machine is fast operating and does not compel operator's
presence after the setting are over. Though a costly circuit . it
its compact, less noisy and also portable . For injection
molulding machines of similar or capacities around 1:5 to 2
gms shot weight ,this programmable logic controller based
circuit can be interfaced. Since the control parameter can be set
by the operators using man machine interface, the overall
machine cycle can be adjusted to suit the industrial
environment.

Further Development Suggested:

This control circuit may be extended to automate the air- bias for ejection also, by interfacing with programmable logic controller of more modules. The pressure to be monitored may be given as input to the processor and the ejection pressure may be made adaptive to the type, since and shape of the plastic fabricated.

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5) "Keyence" Mannuals for "programmable logic controller".

KV SERIES

Super-small Programmable Logic Controllers

The world's smallest PLCs!
KV Series PLCs are small enough to fit just about anywhere yet are powerful and fast enough for even the most demanding control jobs.
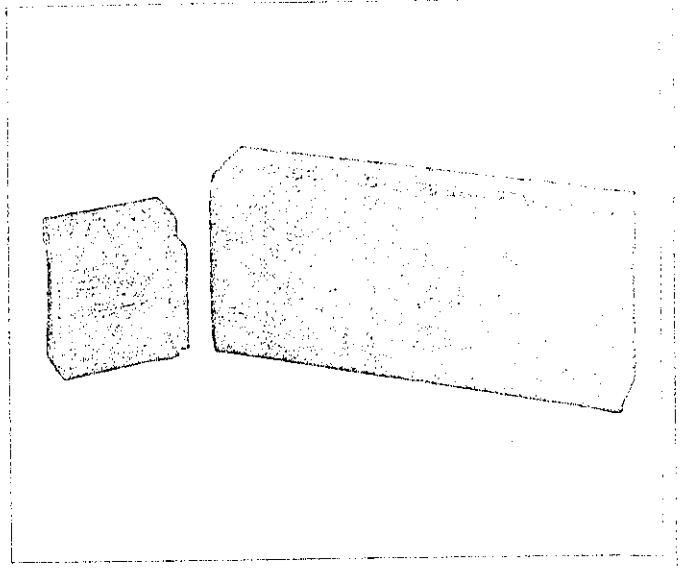
Features

Smallest PLCs in the world

The KV-10 (with 10 I/Os) is about the same size as two general-purpose relays. The KV-80 (with 80 I/Os) is as small as a VHS video tape. KV series PLCs require little space on a control panel.

KV-80
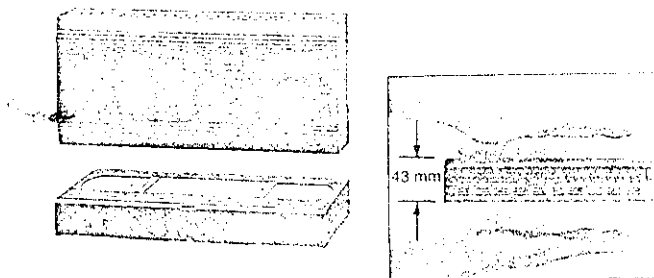
43 mm

VHS video tape   All models are 43 mm thick.

The KV-80 is one fifth the volume or less of conventional 80 I/O PLCs.

The KV series offers several expansion options to increase the number of I/Os.

Up to 4 expansion units can be added.

| | I/O 4 each | 8 inputs | 8 outputs | 16 inputs | 16 outputs |
KV-16   KV-8ET/R   KV-8EX   KV-8ERT/T   KV-16EX   KV-16EYT/R
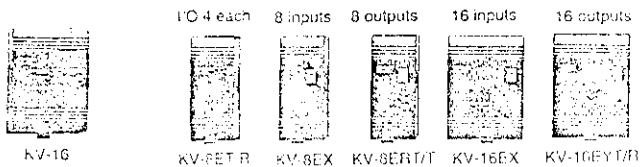
With the KV series, it's easy to expand the number of I/Os. To achieve the input/output ratio that suits your needs, KV-16E or KV-8E expansions units can be added in any combination of 3 to the KV-80 or KV-40. Any combination of 4 expansions units can be added to the other models.

IncrediWare—Powerful support software

The new IncrediWare support software enables you to debug your program on the PC screen without connecting to a PLC or other device.

Interrupts and counters

The interrupt input instruction receives pulse signals as short as 25 μs regardless of the program cycle time, thus allowing real time processing.

The KV series also provides two 10 kHz counters that are suitable for counting pulses with a high frequency.

The KV series has many powerful functions.

Useful during startup, the analog timer trimmer allows you to adjust the values for timers and counters, in real time, based on actual operating conditions, with a range from 0 to 240. 1 analog 2 on/g units in the KV-80, KV-40, and KV-24, and 1 in the KV-16 and KV-10.

20 kHz clock pulse output (KV-80)

The 20 kHz clock pulse output enables positioning at varying speeds. The KV series is useful as a pulse generator for stepping motors. (The KV-10/16/24/40 have a maximum clock frequency of 2 kHz.)

Example of trapezoidal control (ramp up/down control)
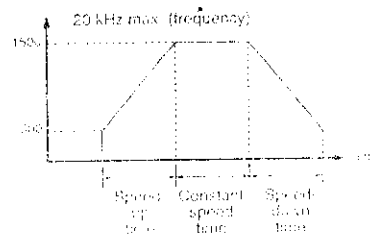
Other Useful features

- Built-in 1 ms timer
- Memory capacity of up to 3000 steps (500 steps KV-10/16)
- Serial communication function
- Relay replacement is possible. (KV-80R, KV-16EYR)
- Programs are stored in EEPROM, eliminating the need for backup battery.

47

System Configuration

KV-10
KV-16
KV-24
KV-40
KV-80

IBM PC/AT
or compatible

Card reader/writer Z-1

For 3.5 inch
floppy disk
For 5 1/4 inch
floppy disk

M-2

M-3

**Programming support software
handheld programmer KV-P3E**
- Palm-size body
- Easy-to see back-lit display (LCD)
  Off-line editor (Programs can be
  edited even when the KV series
  is in RUN mode.)
- Function instructions can be
  easily searched.

Memory card
- Up to 48 programs can be
  stored in the M-3 memory
  card (24 programs in M-2).
- The memory cards are
  useful for changing programs
  at product changeover or
  using the same program
  repeatedly.

Expansion unit
Up to 4 expansion units can be added.
(Up to 3 expansion units can be
connected to the KV-40/80.)

KV-8E   KV-16E

Input/Output Circuit

Input circuit
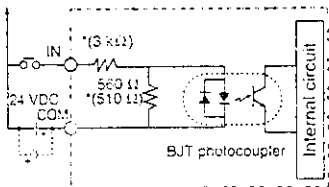
- Applicable to all KV models.
- Used only for terminals connected to relays other
  than 0000 through 0005.
- Input from both NPN [(+) connected to COM] and
  PNP [(-) connected to COM] transistors are ap-
  plicable.

Output circuit (relay contact)
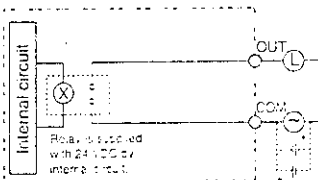
- Applicable only to the KV-80R, KV-40R, KV-24R,
  KV-16R, KV-10R, KV-8ER, KV-8EYR, and KV-
  16EYR.
- A separate power supply is required for the load.

Output circuit (MOS-FET)
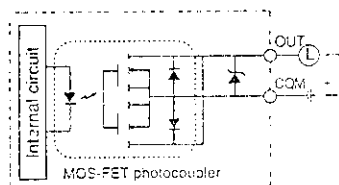
- Applicable only to the KV-40T, KV-24T, and KV-
  16T.
- A separate power supply is required for the load

Output circuit (BJT)
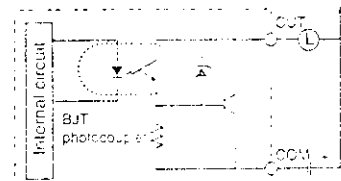
- Applicable only to KV-80T (terminals other than
  0500), KV-10T, KV-8ET, KV-8EYT, and KV-
  16ETY
- A separate power supply is required for the load.

Output circuit (terminal 0500 on KV-
80T only)

- A separate power supply is required for the load.

4-8
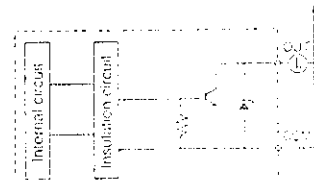
Software

IncrediWare ensures fast, easy programming and efficient desktop debugging.

With IncrediWare KV Ladder Software, you save programming and debugging time. Our original DeskTop Simulator feature lets you check program operation in advance – without first connecting to machinery, I/O devices, or even a PLC. By verifying your program on computer, you can troubleshoot problems before installation, avoiding tedious rewiring and adjustment on-site.
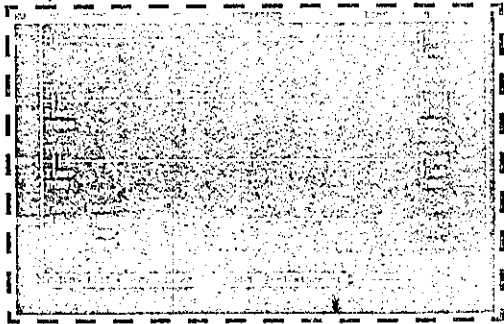
KV Ladder simulator screen

Thorough, detailed program checking

With "one-scan simulation," you can execute the program scan-by-scan. Or use "one-step simulation" to review operation instruction-by-instruction. Now you can check the program in detail while gradually altering I/O status.
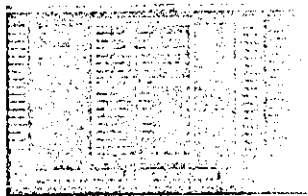
One step

Review multiple I/O status on-screen

Correct errors easily by checking the ON/OFF status of up to 256 I/Os on-screen.
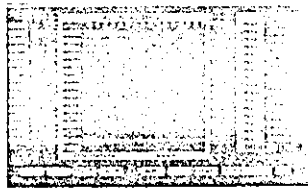
Multiple I/O status

View timing diagrams

Check detailed relationships among I/Os by viewing up to 16 I/Os in timing diagram form.
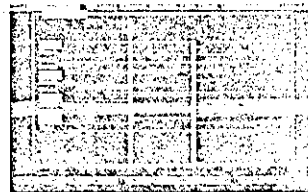
Timing diagram

No PLC required

IncrediWare is a true desktop simulator. Unlike conventional simulators, it requires no machinery, I/O devices, PLC system, or wiring.

Simulate I/Os on a computer keyboard

By assigning up to 16 I/Os to keys on a computer keyboard, you can freely turn I/Os ON/OFF as you test your program.

Symbol List

For more efficient programming, just press the F2 key to display a list of instruction symbols. With all symbols right at your fingertips, you'll program faster than ever before.
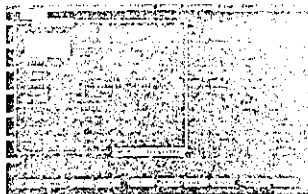
Cut & Past

Copy any part of a program - by line, block, or cell - and paste it at any other position in the program or even in another file.
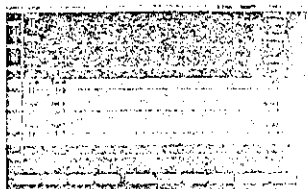
Comment List

If you need to insert a note to explain your program, simply insert a comment in an element cell or on an unused line. You can also list all comments for editing at the same time.
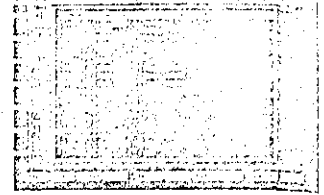
Review Relay Usage

To prevent duplication of relays, you can display up to 256 relays on-screen to review the usage of all relays in a program.
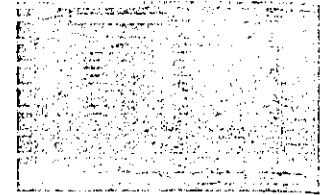
Print

Print all or part of your program in ladder format or as a mnemonic list, either with or without comments. You can select any of five printer types, including IBM (9/24 pin), Epson (9/24 pin), and HP LaserJet.

On-line Help

IncrediWare is so easy to use, you'll learn it in no time. But if you ever need help with an operation, just press the Home key to call up an informative help window.
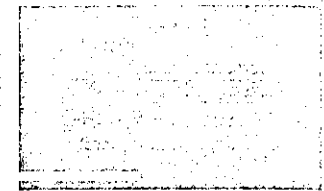
Utilities

With IncrediWare, you can copy, delete, and rename files. Plus, the new file protection function lets you protect important files from loss. As well, the unique converter utility converts between conventional ladder format and Keyence's original extended Ladder format, allowing you to enter relays on a program line as desired.
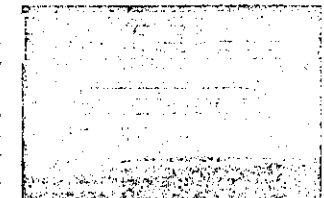
Converting between ordinary and extended ladder formats

KV Ladder software is small enough for any computer configuration

IncrediWare is so compact, it comes on a single floppy disk and requires only 800KB of RAM. For convenience, the installer utility automatically copies all necessary files to your computer while creating a startup batch file.

Specifications

Input/Output Specifications

Type	Basic unit										Expansion unit						
Model	KV-10R	KV-10T	KV-16R	KV-16T	KV-24R	KV-24T	KV-40R	KV-40T	KV-80R	KV-80T	KV-8ER	KV-8ET	KV-8EX	KV-8EYR	KV-8EYT	KV-16EX	KV-16EYR	KV-16EYT
No. of inputs	6		10		16		24		48		4		8	—		16	—	
Common input													2	—		4	—	
Input rating	24 VDC Current consumption 7 mA *input 000 to 005 (5 mA; others)																	
No. of outputs	4		6		8		16		32					8		—	16	
Common output	1		2		4		6		14		1		—	2		—	4	
Type of output	Relay	BJT	Relay	MOS-FET	Relay	MOS-FET	Relay	MOS-FET	Relay	BJT	Relay	BJT	—	Relay	BJT	—	Relay	BJT
Rated load	Relay: 250 VAC 30 VDC, 2 A, peak load current 5 A, Transistor: 30 VDC, 0.3 A MOS-FET: 30 VDC, 0.6 A (Output 0500), 30 VDC, 0.5 A (Others) peak load current 1 A																	

Power Supply Unit Specifications

Model	KV-U2	KV-U3
Operation system	Switching type	
Power supply voltage	100 to 240 VAC (50/60 Hz) ±10%	
Output voltage	24 VDC ±10% (Ripple: 240 m Vp-p max.)	
Output current	0.8A	1.4 A
Weight (brackets not included)	Approx. 170 g	Approx. 200 g

General specifications (R and T in model names indicate Relay output and Transistor output)

Model	KV-10(R/T)	KV-16(R/T)	KV-24(R/T)	KV-40(R/T)	KV-80(R/T)
Programming language	Ladder diagram and expanded ladder diagram				
Number of instructions	Basic: 16, application: 54, arithmetic 26, interrupt: 4				
Execution time (basic I/O instructions)	1.0 µs min. 1.92 µs average		1.4 µs min, 3.12 µs average		
Avg. number of steps	500 steps program		3000 steps program		
Input (Maximum extendable number of inputs)	6 inputs (70 max.)	10 inputs (74 max.)	16 inputs (80 max.)	24 inputs (72 max.)	48 inputs (120 max.)
Output (Maximum extendable number of inputs)	4 outputs (68 max.)	6 outputs (70 max.)	8 outputs (72 max.)	16 outputs (64 max.)	32 outputs (90 max.)
Internal utility relays (with latching function)	160		800		
Special utility relays	160				
Data memory (16 bits)	1,000 words		2,000 words		
Temporary memory (16 bits)	30 words				
Timer/counter	A total of 64 timers, up, and up-down counters are provided: 0.1-s timer (0 to 6553.5 s) 0.01-s timer (0 to 655.35 s) 1-ms timer (0 to 65 535 s) 1-phase timer (0 to 24.9 s, 0 to 2.49 s, or 0 to 0.249 s)		A total of 120 timers, up, and up-down counters are provided. 0.1-s timer (0 to 6553.5 s) 0.01-s timer (0 to 655.35 s) 1-ms timer (0 to 65 535 s) 2 analog timer (two of 0 to 24.9 s, 0 to 2.49 s, or 0 to 0.249 s)		
High-speed counter	2 auto-reset up-counters max. input response frequency 10 kHz				
High-speed counter comparator	4				
Direct clock pulse	2, 2 kHz max. (output from 0500), 1.5 kHz max. (output from 0501)				2, 20 kHz max. (output from 0500), 1.5 kHz max. (output from 0501)
Memory backup	Program memory: EEPROM, programs retained for 10 years min., rewritable 50,000 times min.				
	Data memory: data retained for 2 months min. by capacitors (at 25 C)				
Supply voltage	24 VDC +10% to −20%				
Current consumption	KV-10R: 75 mA max. KV-10T: 65 mA max.	KV-16R: 105 mA max. KV-16T: 70 mA max.	KV-24R: 130 mA max. KV-24T: 75 mA max.	KV-40R: 220 mA max. KV-40T: 115 mA max.	KV-80R: 430 mA max. KV-80T: 310 mA max.
Ambient temperature	0 to 50 C				
Relative humidity	35 to 85%				
Withstand voltage	1500 VAC applied between power terminal and I/O terminal, and between terminals and housing (1 min.)				
Noise immunity	Noise generated by noise simulator 1500 kVp-p max. 1 µs and 50 ns				
Vibration	10 to 55 Hz, double amplitude of 1.5 mm, applied in each of X, Y, and Z directions (2 hours)				
Weight	KV-10R: approx. 130 g KV-10T: approx. 120 g	KV-16R: approx. 200 g KV-16T: approx. 180 g	KV-24R: approx. 250 g KV-24T: approx. 200 g	KV-40R: approx. 340 g KV-40T: approx. 270 g	KV-80R: approx. 600 g KV-80T: approx. 510 g

The maximum extendable number of I/Os of each model is as follows: KV-10 (74), KV-16 (80), KV-24 (68), KV-40 (88), KV-80 (128).

Instructions

Basic Instructions

Instruction	Symbol	Mnemonic	Function
LOAD		LD	Connects N.O. contact to bus.
LOAD BAR		LDB	Connects N.C. contact to bus.
AND		AND	Connects N.O. contact in series with previous contact.
AND BAR		ANB	Connects N.C. contact in series with previous contact.
OR		OR	Connects N.O. contact in parallel with previous contact.
OR BAR		ORB	Connects N.C. contact in parallel with previous contact.
AND LOAD		ANL	Connects in series blocks made of one or more contacts.
OR LOAD		ORL	Connects in parallel blocks made of one or more contacts.
OUT		OUT	Outputs result of ON/OFF status to relay.

Instruction	Symbol	Mnemonic	Function
OUT BAR	nnnn —⊘—	OUB	Outputs inverted input ON/OFF status to R coil.
SET	nnnn —(SET)—	SET	Forces R ON and holds this status when input is ON.
RESET	nnnn —(RES)—	RES	Forces R/T/C OFF when input is ON.
0.1-s TIMER	#ddddd ⊣T xxx⊢	TMR	16-bit on-delay T that counts down in 0.1-s decrements.
0.01-s TIMER	#ddddd ⊣TH xxx⊢	TMH (FNC49)	16-bit on-delay T that counts down in 0.01-s decrements.
1-ms TIMER	#ddddd ⊣TS xxx⊢	TMS (FNC51)	16-bit on-delay T that counts down in 1-ms decrements.
COUNTER	#ddddd ⊣C xxx⊢ nnnn	C	Sets 16-bit up-counter.

Applications Instructions

Instruction	Symbol	Mnemonic	Function
UP-DOWN COUNTER	UDCxxx UP #ddddd DW RES	UDC (FNC52)	Sets a 16-bit up-down counter.
DIFFERENTIATE UP	nnnn ⊣ DIFU ⊢	DIFU (FNC10)	Turns ON R for 1 scan time at rising edge of input.
DIFFERNTIATE DOWN	nnnn ⊣ DIFD ⊢	DIFD (FNC09)	Turns ON R for 1 scan time at falling edge of input.
KEEP	KEEP Set nnnn Res	KEEP (FNC22)	Turns ON R and holds this status when SET input is ON. Turns OFF R when RESET input is ON.
SHIFT	SFT UP nnnn DW	SFT (FNC39)	Sets shift register.
HIGH SPEED	HSP nnnn	HSP (FNC18)	Reduces input relay time constant to 25 μs for higher input response.
MASTER CONTROL	MC	MC (FNC24)	Selects ON/OFF status of R coils, Ts, or Cs.
MASTER CONTROL RESET	MCR	MCR (FNC25)	Represents end of MC.
MEMORY SWITCH	MEMSW	MEMSW (FNC26)	Sets memory switches.
STAGE	nnnn ⊣ STG ⊢	STG (FNC 44)	Executes instructions between STG & JMP when R (operand) is ON.
JUMP	nnnn ⊣ JMP ⊢	JMP (FNC 21)	Turns current stage OFF and next stage ON when input is ON.
END STAGE	⊣ ENDS ⊢	ENDS (FNC 14)	Turns current stage OFF when input is ON.
NOP	————	NOP (FNC30)	Performs no operation.
END	END	END	Indicates end of each routine of program.
END HI	ENDH	ENDH	Indicates end of entire program.

Application Instructions

Instruction	Mnemonic
STEP	STP
STEP END	STE
INTERVAL TIMER	ITVL
8 BIT COUNTER	CTH
8 BIT COUNTER COMPARATOR	CTC
SUBROUTINE CALL	CALL
SUBROUTINE ENTRY	SBN
SUBROUTINE RETURN	RET
REPEAT START	FOR
REPEAT END	NEXT
18 KEY INPUT	KEY
WAIT ON	W-ON
WAIT OFF	W-OFF

WAIT UP EDGE	W-UE
WAIT DOWN EDGE	W-DE
CONNECT	CON
PUSH	MPS
READ	MRD
POP	MPP

Interrupt Instructions

INTERRUPT DISABLED	DI
INTERRUPT ENABLED	EI
INTERRUPT	INT
RETURN INTERRUPT	RETI

Arithmetic Instructions

DATA MEMORY WRITE	DW	ROTATE RIGHT A	RRA
TRIGGER SETING	TMIN	ROTATE LEFT A	RLA
LOAD A	LAD	COMPLEMENT	COL
STORE A	STA	INCREMENT MEMORY	INC
COMPARE	CMP	DECREMENT MEMORY	DEC
ADD	ADD	MULTIPLEXER	MPX
SUBTRACT	SUB	DEMULTIPLEXER	DMX
MULTIPLY	MUL	TRANSFER BCD	TBCD
DIVIDE	DIV	TRANSFER BIN	TBIN
AND A	ANDA	ASCII CONVERT	ASC
OR A	ORA	REVERSE ASCII CONVERT	DASC
EXCLUSIVE OR A	EORA	SQUARE ROOT	ROOT
ROTATE RIGHT A	RRA		
SHIFT LEFT A	SLA		

KEYENCE

Dimensions

Unit: mm

KV-80R/T

4 x ø5 mounting hole

93
35.4 90 111
160
200
39
43

KV-40R/T

2 x ø5 mounting hole

35.4 90 111
78
110
39
43

KV-24R/T

2 x ø5 mounting hole

99
35.4 90 111
48
80
39
43

KV-16R/T • 16EX • 16EYR/T

2 x ø5 mounting hole

35.4 90 111
31
65
39
43

KV-10R/T

2 x ø5 mounting hole

79
35.4 90 111
44
60

KV-8ER/T•8EX•8EYR/T

2 x ø5 mounting hole

35.4 90 111
39
43

KV-U2

2 x ø5 mounting hole

79
35.4
50
56
70

KV-U3

2 x ø5 mounting hole

99
35.4 90 111
78
70

KV-P3E

90
29.5
70

5 2.
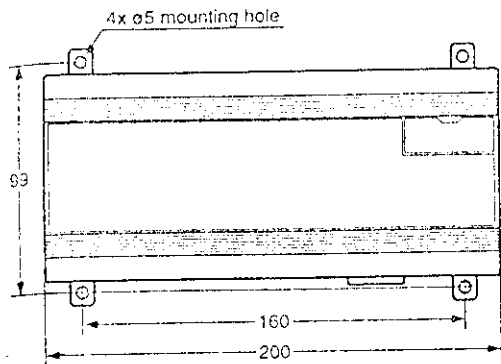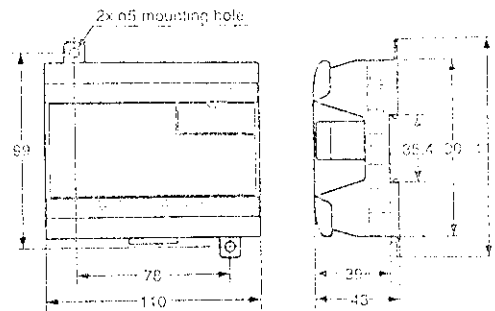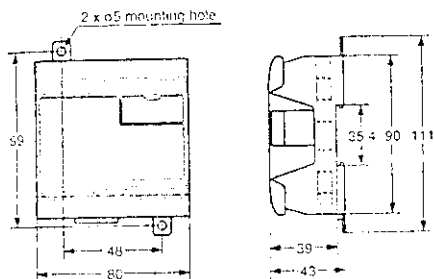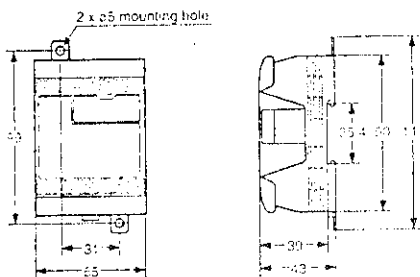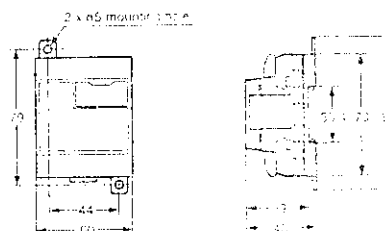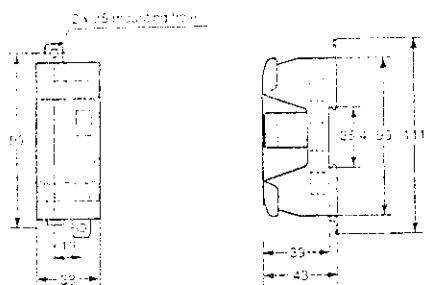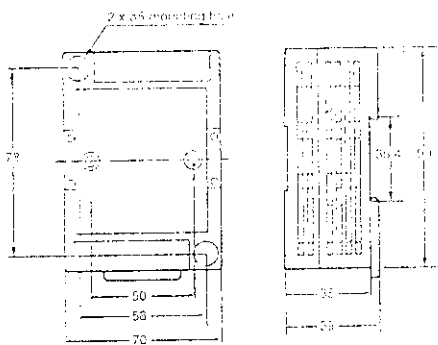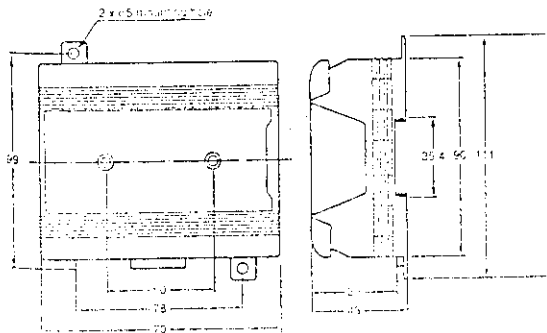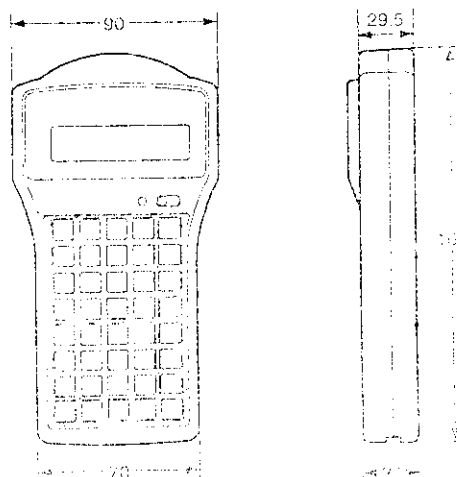
Proximity Sensors

Overview

The proximity sensor, replacing mechanical switches such as the limit switch and microswitch, offers non-contact detection of objects entering the detection range. Proximity sensors can be broadly categorized into the following three types according to operating principle: the high-frequency oscillation type based on electromagnetic induction, the magnetic type, and the capacitance type based on electrostatic capacity. KEYENCE proximity sensors are of the high-frequency oscillation type.

Operating principle
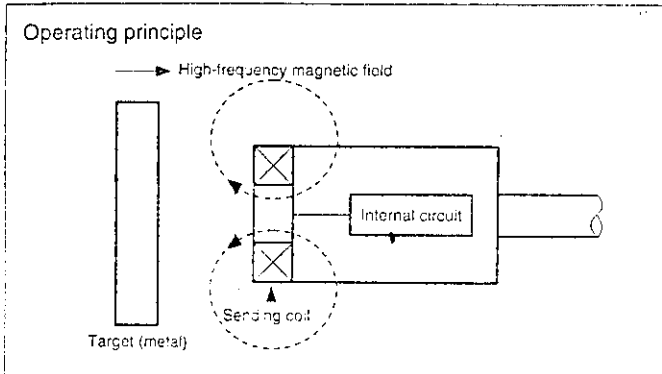
When a target travels toward the high-frequency magnetic fields generated by the sensing coil, an induction current (eddy current) is created on the target which increases the impedance of the coil and finally causes oscillation to stop, thereby signaling target detection.

Features

- Non-contact detection, eliminating damage to sensor head and target.
- Non-contact output, ensuring long service life.
- Stable detection even in harsh environments exposed to water or oil splash.
- High response speed.
- Compact sensor head for installation flexibility.

Shielded and non-shielded types

- Shielded
  The sensing coil is encased in a metal-shielding, allowing it to be embedded in a metal base.
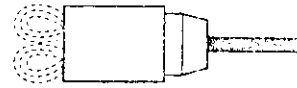
- Non-shielded
  The sensing coil is not metal-shielded. This type provides a longer detecting distance than the shielded type, but, it is easily affected by surrounding metal.
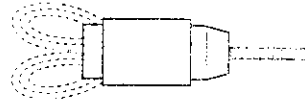
ction Chart

Type	Self-contained proximity sensor	Separate/In-cable amplifier
Features	• Readily operative by adding DC power supply.	• Compact sensor head • Long detecting distance
Standard configuration	Oscillation circuit → Detecting circuit → Output circuit Sending coil	Oscillation circuit → Detecting circuit → Output circuit Sending coil / Coaxial cable

Type	Self-contained proximity sensor		In-cable amplifier	Separate amplifier	Metal passage
Features	• Simple wiring • Highly flexible cable joint		• High response speed • Simple wiring	• High accuracy • Detecting distance easily varied • Low hysteresis	• Detects small objects • Detects at any point within the window
Sensor head	3-wire	2-wire			
Amplifier					
Power supply	DC	DC / AC	DC	DC / AC	AC
Output	Non-contact	Non-contact	Non-contact	Non-contact	Non-contact/contact
Sensor series	EZ·ED	EV	EM	ES/ES-X·ET	TA
See page	136·152	136	132	142·150	164

EM SERIES

In-cable Amplifier Small Proximity Sensors

Ultra-small sensor head with amplifier and easy-to-see operation indicator built into the cable.

$C \in$
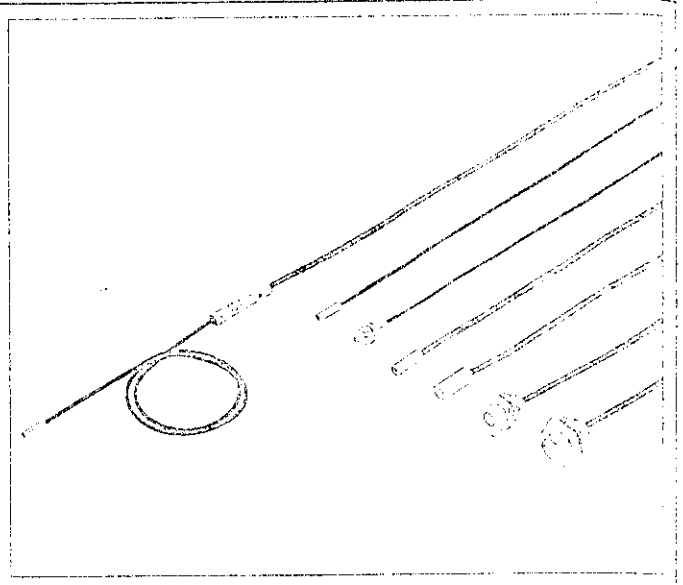
Features

Compact sensor heads

With a sensor head diameter as small as 3 mm for the cylindrical type and M5 for the threaded type, the EM series sensor is an effective space-saver.

```
   ⊢— 12 mm —⊣
φ 3 mm
```
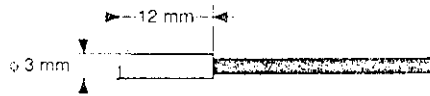
(Actual size)

Reduced length

The sensor head is half the length of conventional self-contained proximity sensor proximity sensors of the M8 size. This enables the EM series to be installed in locations of limited space, thereby broadening its range of applications.

Conventional M8-type sensor

EM-080
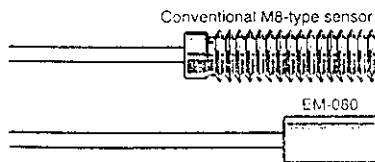
Sealed housing for effective oil and water resistance

Both sensor head and amplifier are tightly sealed for a high degree of protection, meeting IEC standard IP-67.

PNP/NPN output

Both PNP and NPN open-collector output types are available for all models.

Visible output indicator

The output indicator is located on the amplifier housing installed in the cable, enabling sensor operation to be easily confirmed.
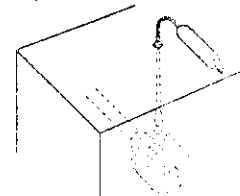
Flexible cable

The output cable is made of a high-tensile copper alloy giving it a flexibility 5 times greater than conventional sheathed cables.
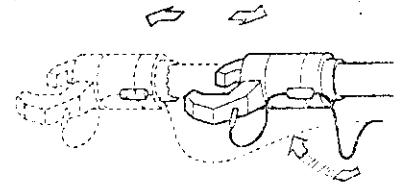
Parallel installation

The alternate-frequency type EM series sensors can be installed next to each other without causing interference.
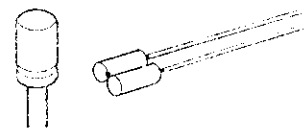
Applications
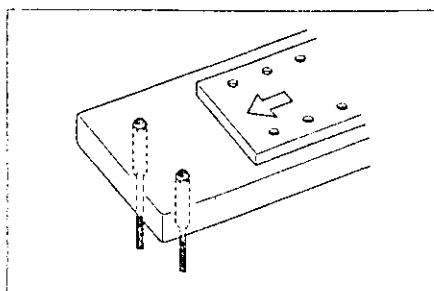
Detection of small holes in workpiece
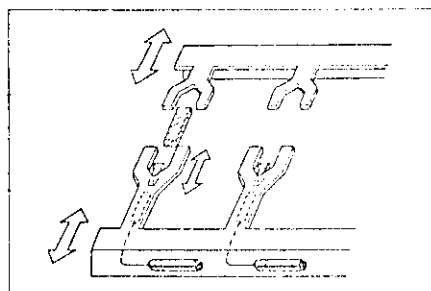
Confirmation of proper gripping action of transfer press
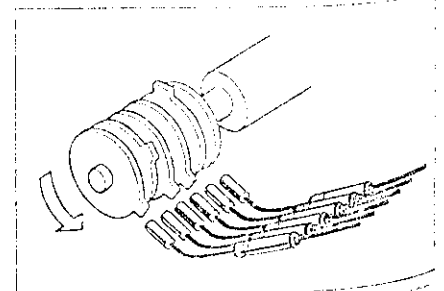
Detection of switching position of cam

Selection Chart

Type	Size	Shape	Detecting distance	Model	
				NPN output	PNP output
Shielded	3 mm dia.		0.6 mm	EM-030	EM-030P
	3.8 mm dia.		0.8 mm	EM-038	EM-038P
	M5		1 mm	EM-005	EM-005P
	5.4 mm dia.		1.2 mm	EM-054	EM-054P
	8 mm dia.		2 mm	EM-080	EM-080P
	M10		2 mm	EM-010	EM-010P
	M14		4 mm	EM-014	EM-014P

Specifications

Type		Shielded						
		Cylindrical		Threaded	Cylindrical		Threaded	
Model	NPN output	EM-030	EM-038	EM-005	EM-054	EM-080	EM-010	EM-014
	PNP output	EM-030P	EM-038P	EM-005P	EM-054P	EM-080P	EM-010P	EM-014P
Size		3 mm dia.	3.8 mm dia.	M5	5.4 mm dia.	8 mm dia.	M10	M14
Detecting distance		0.6 mm ±15%	0.8 mm ±15%	1.0 mm ±15%	1.2 mm ±10%	2.0 mm ±10%	2.0 mm ±10%	4.0 mm ±10%
Detectable object		Ferrous metals (see Characteristics for nonferrous metals)						
Standard target (iron, t=1 mm)		5 x 5 mm			6 x 6 mm	10 x 10 mm		15 x 15 mm
Hysteresis		10% max. of detecting distance						
Response frequency		1.2 kHz						
Temperature fluctuation		±10% max. of detecting distance at +23 °C (–10 to +70 °C)						
Indicator		Output: Red LED						
Control output		NPN or PNP open-collector: 100 mA (40 V) max. Residual voltage: 1 V max.						
Power supply		10.8 to 30 VDC Ripple (p-p): 10% max.[1]						
Current consumption		12 mA max.						
Enclosure rating		IP-67						
Ambient temperature		–25 to +80 °C						
Relative humidity		35 to 95%						
Housing		Stainless steel					Cr-plated brass	
Weight (including nuts and 2-m cable)		Approx. 36 g	Approx. 38 g	Approx. 40 g	Approx. 40 g	Approx. 42 g	Approx. 50 g	Approx. 60 g

1. If the output voltage contains a ripple, be sure to use the supply voltage within a range of 10.8 to 30 VDC.

Output Circuit

NPN output

PNP output

Characteristics

Detecting range (Typical)

EM-030P/030 — Standard target: iron 5 × 5 × 1
EM-038P/038 — Standard target: iron 5 × 5 × 1
EM-005P/005 — Standard target: iron 5 × 5 × 1
EM-014P/014

EM-080P/080 — Standard target: iron 10 × 10 × 1
EM-010P/010 — Standard target: iron 10 × 10 × 1
EM-014P/014 — Standard target: iron 15 × 15 × 1

Detecting distance vs. size and material of target (Typical)

EM-030P/030 — Iron, Stainless steel, Brass, Aluminum, Copper
EM-038P/038 — Iron, Stainless steel, Brass, Aluminum, Copper
EM-005P/005 — Iron, Stainless steel, Brass, Aluminum, Copper
EM-014P/014 — Iron, Stainless steel, Brass, Aluminum, Copper

EM-080P/080 — Iron, Stainless steel, Brass, Aluminum, Copper
EM-010P/010 — Iron, Stainless steel, Brass, Aluminum, Copper
EM-014P/014 — Iron, Stainless steel, Brass, Aluminum, Copper

Hints on Correct Use

Mounting

Sensor head

- Cylindrical type
  Secure the sensor head with a screw at a position 5 mm or more from the tip of the head. [Tightening torque: 0.4 Nm (approx. 4 kgf·cm max.]
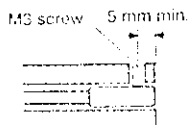
M3 screw   5 mm min.

- Threaded type
  When mounting the threaded-type sensor head, do not tighten beyond the torque specified in the following table.

Model	Tightening torque
EM-005(P)	1.5 Nm (approx. 15 kgf·cm) max.
EM-010(P)	10 Nm (approx. 100 kgf·cm) max.
EM-014(P)	20 Nm (approx. 200 kgf·cm) max.

Amplifier

Use the attached mounting bracket to secure the amplifier.
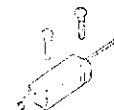
Wiring

- Isolate the sensor wiring from power lines and high-voltage lines; otherwise the sensor may malfunction due to noise interference.
- To extend the cable, use a cable with a nominal cross-section of 0.3 mm² or more. Limit the length of extension to within 50 m. The coaxial cable must not be extended or cut.

Surrounding metal

When embedding the sensor in an iron base, follow the guidelines given below in order to minimize interference from the surrounding metal.
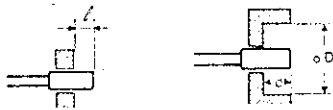
Model	l (mm min.)	D (mm min.)	d (mm min.)
EM-030(P)	4	6	5
EM-038(P)	4	7.6	5
EM-005(P)	4	10	5
EM-054(P)	4	10.8	5
EM-080(P)	5	16	8
EM-010(P)	5	20	8
EM-014(P)	5	28	8

Interference

When installing 2 sensors of the same model face-to-face or in parallel, separate by the distance specified in the following table to prevent interference.

Distance / Model	Face-to-face (mm min.)	Parallel (mm min.)
EM-030(P)	12 (1)	11 (*)
EM-038(P)	15 (1)	12 (*)
EM-005(P)	12 (1.5)	13 (*)
EM-054(P)	20 (1.5)	18 (*)
EM-080(P)	24 (2.5)	23 (*)
EM-010(P)	20 (2.5)	25 (*)
EM-014(P)	40 (4.5)	34 (*)

Note: The values in parentheses apply to the alternate-frequency type.
(*) Side by side installation is possible.

Dimensions

Unit: mm

EM-030/030P
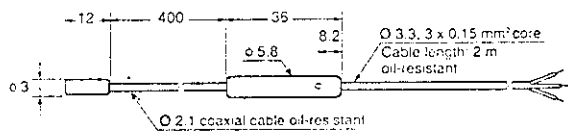
EM-038/038P
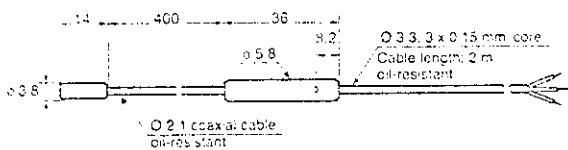
EM-005/005P
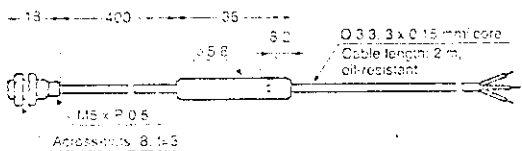
EM-054/054P
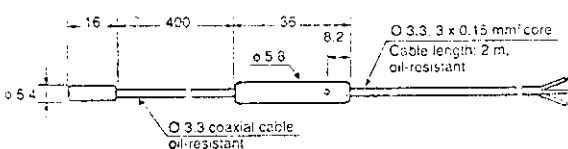
EM-080/080P
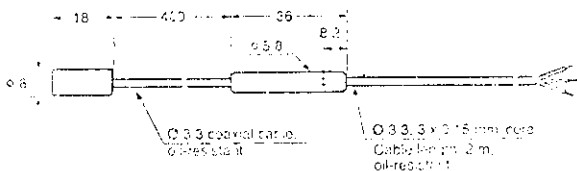
EM-010/010P
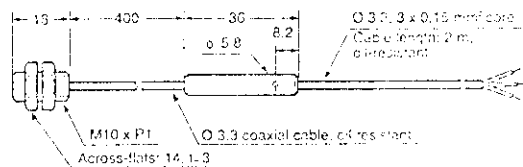
EM-014/014P
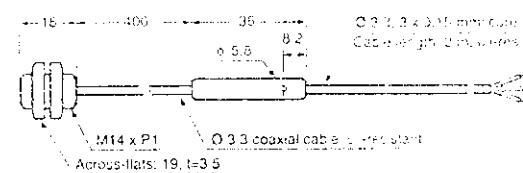
Detail of output indicator
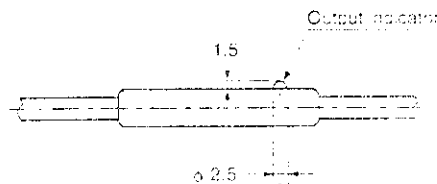
Amplifier mounting bracket (accessory)
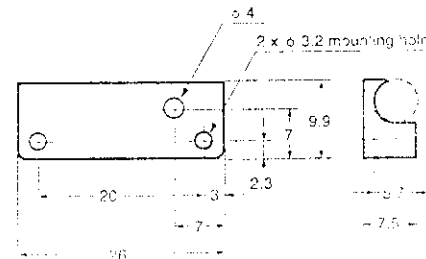
EZ/EV SERIES

Self-contained Proximity Sensors

Compact sensor head.

Visible operation indicator built into the sensor.
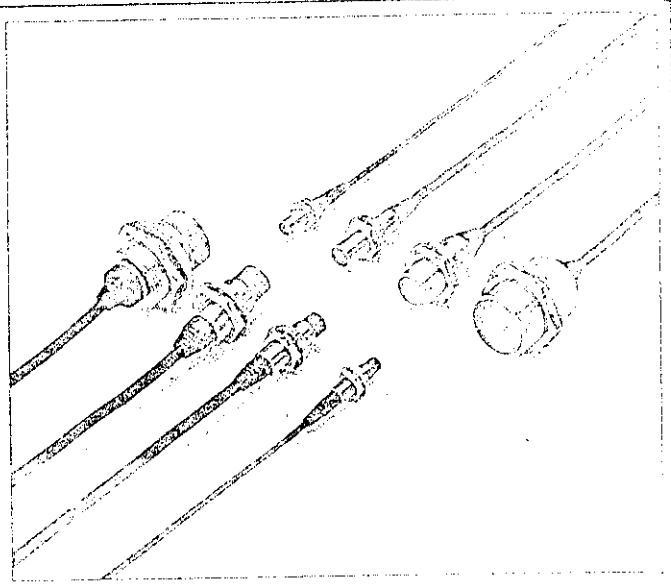
Features

Space-saving
With a sensor body up to 30% shorter than previous models, the EZ/EV series proximity sensor offers high sensitivity and long detecting distance.

Easy-to-see output indicator
An output indicator is built into the sensor unit in such a manner that sensor operation can be easily confirmed from virtually any angle.
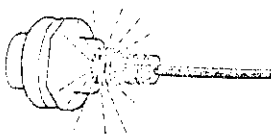
Flexible joint
The cable is connected to the sensor head with a rigidly flexible joint that can be bent to a 90-degree angle, thus preventing cable wire breakage.
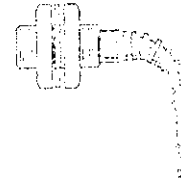
Waterproof
The housing/cable joint is protected by a cable guard built into the cable which prevents liquid from penetrating the internal circuitry.

Selection Chart

Type		Size	Detecting distance	Model
DC 3-wire	Shielded	M8	1.5 mm	EZ-8M
		M12	2.5 mm	EZ-12M
		M18	5 mm	EZ-18M
		M30	10 mm	EZ-30M
		Flat	5 mm	EZ-18T
DC 2-wire	Shielded	M8	1.5 mm	EV-108M
		M12	2.5 mm	EV-112M
		M18	5 mm	EV-118M
		M30	10 mm	EV-130M
	Non-shielded	M8	4 mm	EV-108U[1]
		M12	8 mm	EV-112U
		M18	15 mm	EV-118U
		M30	27 mm	EV-130U
AC 2-wire	Shielded	M12	2.5 mm	EV-12M[1]
		M18	5 mm	EV-18M[1]
		M30	10 mm	EV-30M[1]

1. This product does not comply with EC directive.

EV-F series
A spatter-resistant type is also available. This model has a Teflon™ detecting surface and Teflon-coated threads, nuts, and washers to repel welding spatter.

Sensor housing:
Teflon™-coated

Detecting surface:
Teflon™

Nut/washer:
Teflon™-coated
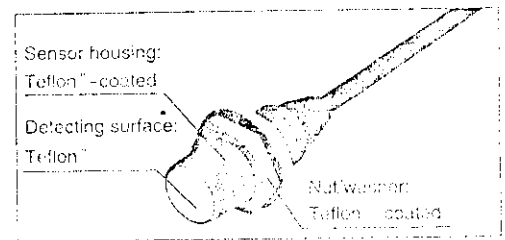
Type	Shielded, Teflon™-coated		
Model	EV-112F	EV-118F	EV-130F
Size	M12	M18	M30
Detecting distance	2.5 mm	5 mm	10 mm
Hysteresis	18% max. of detecting distance		
Housing	Teflon™-coated brass		

Specifications and dimensions for the models listed in the above table are identical to those for EV-112M/118M/130M (DC 2-wire type), of the same nominal size.

Teflon™ is a trademark of Du Pont Chemical Company.

Specifications

DC 3-wire type

Type			Shielded		
Model	EZ-8M	EZ-12M	EZ-18M	EZ-30M	EZ-18T
Size	M8	M12	M18	M30	30 x 8 x 8 mm
Detecting distance	1.5 mm ±10%	2.5 mm ±10%	5 mm ±10%	10 mm ±10%	5 mm ±10%
Detectable object			Ferrous metals (see Characteristics for nonferrous metals)		
Standard target (iron, t=1)	10 x 10 mm	12 x 12 mm	18 x 18 mm	30 x 30 mm	18 x 18 mm
Hysteresis			10% max. of detecting distance		
Response frequency	800 Hz	600 Hz	350 Hz	250 Hz	350 Hz
Temperature fluctuation			±10% max. of detecting distance at +23 °C (−25 to +70 °C)		
Operation mode			N.O. N.C.		
Control output			NPN open-collector: 100 mA max. (40 V max.). Residual voltage: 1 V max.		
Power supply			12 to 24 VDC ±10%. Ripple (p-p): 10% max.		
Current consumption			13 mA max.		
Enclosure rating			IP-67		
Ambient temperature			−25 to +50 °C		
Relative humidity			35 to 95%		
Vibration			10 to 55 Hz, 1.5 mm double amplitude in X, Y, and Z directions, 2 hours respectively		
Shock	50 Gs in X, Y, and Z directions, 3 times respectively		100 Gs in X, Y, and Z directions, 3 times respectively		
Housing	Stainless steel		Nickel-plated brass		Aluminum die-cast
Cable length			2 m		
Weight (including cable and nuts)	Approx. 50 g	Approx. 65 g	Approx. 130 g	Approx. 235 g	Approx. 55 g

DC 2-wire type

Type	Shielded				Non-shielded			
Model	EV-108M	EV-112M	EV-118M	EV-130M	EV-108U[1]	EV-112U	EV-118U	EV-130U
Size	M8	M12	M18	M30	M8	M12	M18	M30
Detecting distance	1.5 mm ±10%	2.5 mm ±10%	5 mm ±10%	10 mm ±10%	4 mm ±10%	8 mm ±10%	15 mm ±10%	27 mm ±10%
Detectable object			Ferrous metals (see Characteristics for nonferrous metals)					
Standard target (iron, t=1 mm)	10 x 10 mm	12 x 12 mm	18 x 18 mm	30 x 30 mm	20 x 20 mm	30 x 30 mm	60 x 60 mm	70 x 70 mm
Hysteresis		10% max. of detecting distance				20% max. of detecting distance (−10 to +70 °C)		
Response frequency	800 Hz	600 Hz	350 Hz	250 Hz	800 Hz	600 Hz	350 Hz	250 Hz
Temperature fluctuation		±10% max. of detecting distance at 23 °C (−25 to +70 °C)				+10% max. of detecting distance (−10 to +70 °C)		−5 to +70°C ±15% +70°C
Operation mode			N.O. (N.C. output not available for all models)					
Control output (switching capacity)	5 to 50 mA	5 to 200 mA			5 to 20 mA	5 to 20 mA		
Protection circuit	Reversed polarity, surge voltage	Reversed polarity, short-circuit, surge voltage			Reversed polarity, surge voltage	Reversed polarity, short-circuit, surge voltage		
Power supply			12 to 24 VDC. Ripple (p-p): 20% max.					
Ratings			Current consumption (leakage current): 1.0 mA max. Residual voltage: 3.0 V max. (with 2-m cable)					
Enclosure rating			IP-67					
Ambient temperature			−25 to +50 °C					
Relative humidity			35 to 95%					
Vibration			10 to 55 Hz, 1.5 mm double amplitude in X, Y, and Z directions, 2 hours respectively					
Shock	50 Gs in X, Y, and Z directions, 3 times respectively		100 Gs in X, Y, and Z directions, 3 times respectively		50 Gs in X, Y, and Z directions, 3 times respectively		100 Gs in X, Y, and Z directions, 3 times respectively	
Housing	Stainless steel		Nickel-plated brass		Stainless steel		Nickel-plated brass	
Cable length			2 m					
Weight (including cable and nuts)	Approx. 42 g	Approx. 110 g	Approx. 150 g	Approx. 300 g	Approx. 42 g	Approx. 110 g	Approx. 150 g	Approx. 300 g

AC 2-wire type

		Shielded	
Model	EV-112M[1]	EV-118M[1]	EV-130M[1]
Size	M12	M18	M30
Detecting distance	2.5 mm ±10%	5 mm ±10%	10 mm ±10%
Detectable object		Ferrous metals (See Characteristics for nonferrous metals)	
Standard target (iron, t=1 mm)	12 x 12 mm	18 x 18 mm	30 x 30 mm
Hysteresis		10% max. of detecting distance	
Response frequency		25 Hz	
Temperature fluctuation		±10% max. of detecting distance at +23°C (−25 to +70°C)	
Operation mode		N.O.	
Control output (switching capacity)		5 to 200 mA	
Protection circuit		Short-circuit	
Power supply		24 to 240 VAC, 50/60 Hz	
Current consumption (leakage current)		1.3 mA max. (at 240 VAC)	
Enclosure rating		IP-67	
Ambient temperature		−25 to +50 °C	
Relative humidity		35 to 95%	
Vibration		10 to 55 Hz, 1.5 mm double amplitude in X, Y, and Z directions, 2 hours respectively	
Shock	50 Gs in X, Y, and Z directions, 3 times respectively	100 Gs in X, Y, and Z directions, 3 times respectively	
Housing		Nickel-plated brass	
Cable length		2 m	
Weight (including cable and nuts)	Approx. 110 g	Approx. 150 g	Approx. 300 g

[1] This sensor does not comply with EMC directives.

Connections

EZ series: DC 3-wire type

Drive-current load

Brown
Black — Output 1
Load
White
Load
Blue — Output 2
12 to 24 VDC
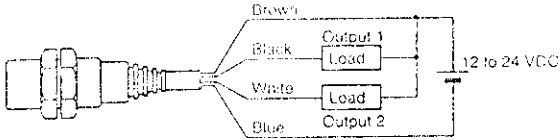
Black (output 1): N.O.
White (output 2): N.C.

EV series: DC 2-wire type

Load
Brown
Blue
12 to 24 VDC
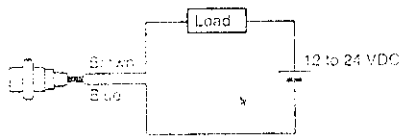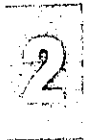
Connection to built-in DC power supply type PLC (externally – connected power supply)

+24 V
Brown   IN
Blue   COM
0 V
PLC

EV series: AC 2-wire type

Load
Brown
Blue
24 to 240 VAC
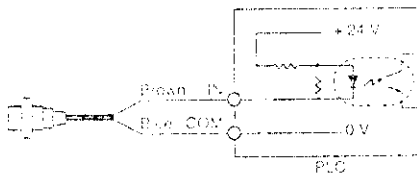
Connection to built-in DC power supply type PLC (internally – connected power supply)

COM
Brown
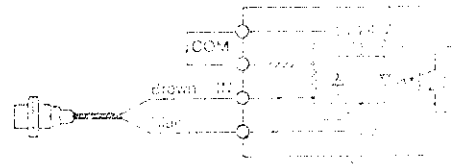
Connection to PLC lack in internal DC power supply

For connections indicated by the dotted line, use a it in series with the sensor wires.
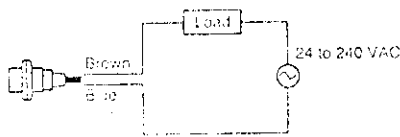
Series connection:
Up to 3 proximity sensors can be connected in series. The supply voltage must be within the range of 24 to 240 VAC. If operation is unstable, connect resistors with a resistance of 560 kΩ to 1 MΩ parallel to the sensor in order to balance the supply voltage.

Parallel connection
Connect proximity sensors in parallel only if the sensors do not operate simultaneously. Note, however, that the leakage current will increase in proportion to the number of sensors connected.
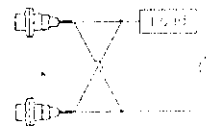
Output Circuit

EZ series
DC 3-wire type

EV series
DC 2-wire type*
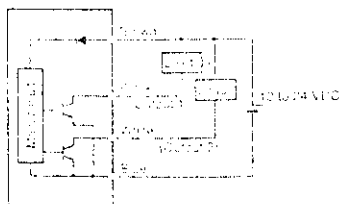
EV series
AC 2-wire type
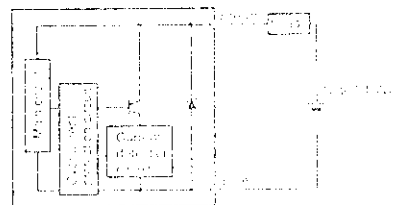
* The M8 sensor does not contain a short-circuit protection circuit or current detection circuit.
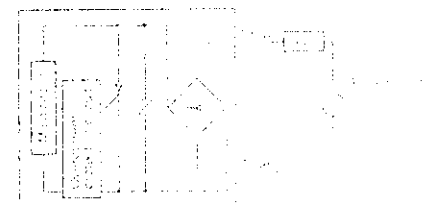
Characteristics

Detecting range (Typical)
DC 3-wire type

EZ-8M — Standard target 10 × 10 × 1t iron
EZ-12M — Standard target 12 × 12 × 1t iron
EZ-18M — Standard target 18 × 18 × 1t iron
EZ-30M — Standard target ...

DC 2-wire type

EZ-18T — Standard target 18 × 18 × 1t iron
EV-108M — Standard target 10 × 10 × 1t iron
EV-112M — Standard target 12 × 12 × 1t iron
EV-118M — ...

EV-130M — Standard target 30 × 30 × 1t iron
EV-108U — Standard target 20 × 20 × 1t iron
EV-112U — Standard target 30 × 30 × 1t iron
EV-118U — ...

AC 2-wire type

EV-130U — Standard target 70 × 70 × 1t iron
EV-12M — Standard target 12 × 12 × 1t iron
EV-18M — Standard target 18 × 18 × 1t iron
EV-30M — ...

Detecting distance vs. size and material of target (Typical)
DC 3-wire type

EZ-8M
EZ-12M
EZ-18M
EZ-30M

Detecting distance vs. size and material of target (Typical)

Unit: mm

DC 3-wire type   DC 2-wire type

EV-18T, EV-108M, EV-112M, EV-118M — Iron, Stainless steel, Brass, Aluminum, Copper; Detecting distance Y vs. One side of target X

EV-130M, EV-108U, EV-112U, EV-118U

AC 2-wire type

EV-18U, EV-12M — Iron, Stainless steel, Brass, Aluminum, Copper
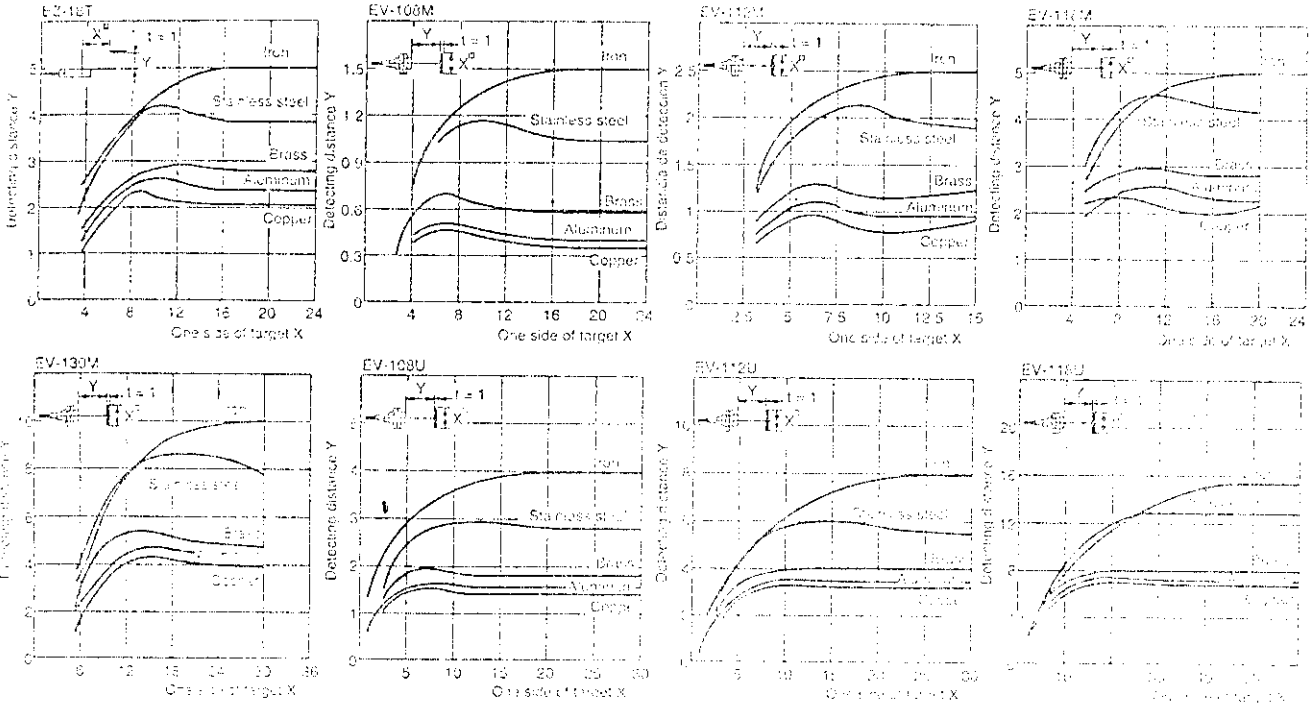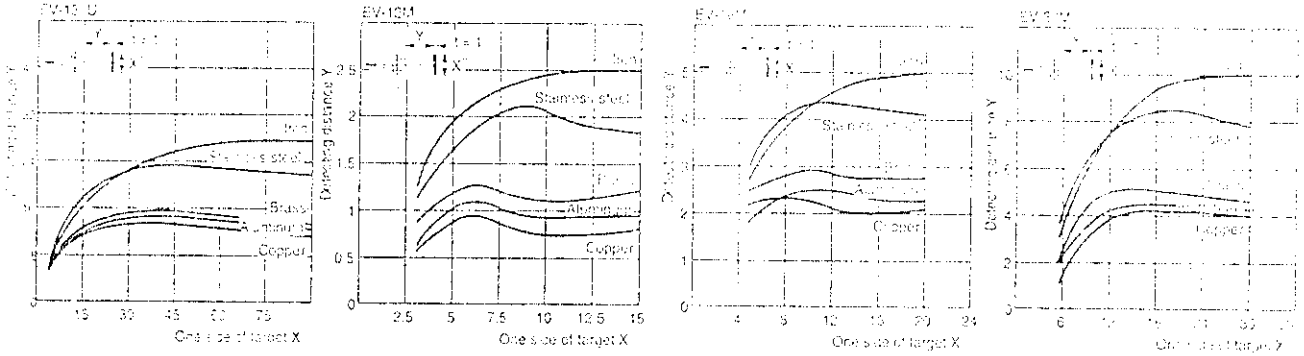
Residual voltage (Typical)   Leakage current (Typical)
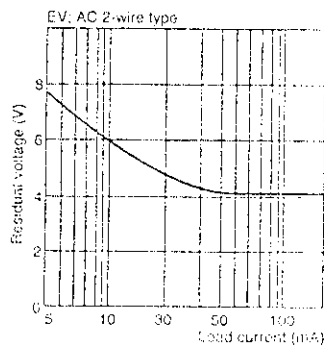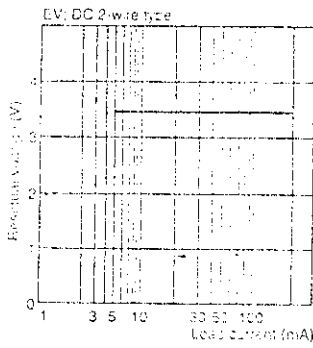
EV: DC 2-wire type — Residual voltage (V) vs. Load current (mA)

EV: AC 2-wire type — Residual voltage (V) vs. Load current (mA)

EV: DC 3-wire type — Leakage current (mA) vs. Supply voltage (V)

EV: AC 2-wire type — Leakage current (mA)
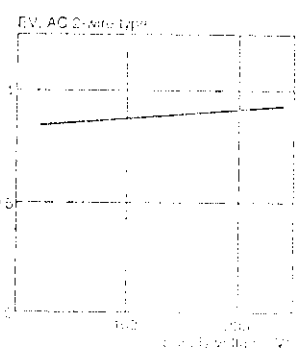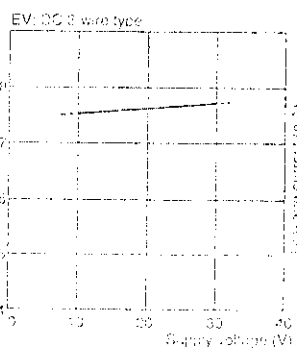
Hints on Correct Use

Mounting

When mounting the sensor, insert the attached toothed washer. Do not tighten beyond the torque specified in the following table.
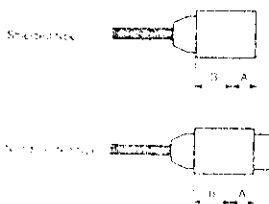
Model	Dimension A (mm)	At A	At B
EZ-6M	3	3 N·m (approx. 30 kgf·cm) max.	5 N·m (approx.) max.
EV-108M, EV-108U	3	9 N·m (approx. 90 kgf·cm) max.	9 N·m (approx. 90 kgf·cm) max.
EZ-12M	6	6 N·m (approx. 60 kgf·cm) max.	
EZ-18M	8	15 N·m (approx. 150 kgf·cm) max.	
EV-12M, EV-112M, EV-112U	6	15 N·m (approx. 150 kgf·cm) max.	
EV-18M, EV-118M, EV-118U	7	N·m (approx. 500 kgf·cm) max.	
EZ-30M	12	5 N·m (approx. 500 kgf·cm) max.	
EV-30M, EV-130M, EV-13		N·m (approx. 1000 kgf·cm) max.	

50

KEYENCE

Wiring

Isolate the sensor cable from power lines or high-voltage lines; otherwise the sensor may malfunction due to noise interference. The sensor cable may be extended up to 100 m (EZ series), or 200 m (EV series), using a cable with a nominal cross-section area equal to or greater than that of the attached cable.

Surrounding metal

Shielded-type sensors can be flush-mounted in a metal base. Sensors of the non-shielded type, however, should be mounted according to the guidelines given below in order to minimize interference from the surrounding metal.
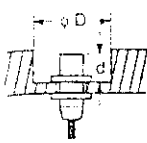
Model	D (mm min.)	d (mm min.)
EV-108U	25	13
EV-112U	55	20
EV-118U	70	25
EV-130U	120	28

Interference

When installing 2 or more sensors of the same model face-to-face or parallel separate by the distance specified in the following table to prevent interference.

Model	Face-to-face (mm min.)	Parallel (mm min.)
Z-8M	20	23
Z-12M	30	32
Z-18M	40	48
Z-30M	100	100
V-108M	20	11
V-112M, EV-12M	30	22
V-118M, EV-18M	40	28
V-130M, EV-30M	100	50
V-108U	30	26
V-112U	55	62
V-118U	75	98
V-130U	160	180

Model	(mm)	(mm)
EZ-18T	40	65

Effects of leakage current

With a 2-wire proximity sensor, a small amount of current flows (leakage current) to keep the circuit operating even when the sensor is turned OFF. (Refer to graph "Leakage current characteristic".) Because of this current, a low voltage remains on the load, perhaps preventing the load from properly resetting. Before operation, check that the residual voltage is lower than the reset voltage of the load.

When the load current is low

When the load current is less than 5 mA, connect a bleeder resistor to give the sensor 5 mA or more load current. Make sure the residual voltage is less than the reset voltage of the load.
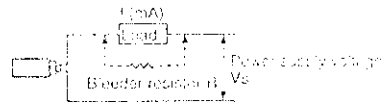
Calculate the resistance (R) and rated bleeder resistor wattage (P) from the following expressions:

AC 2-wire type:

$$R < \frac{V}{5 - I} \, (k\Omega) \qquad P > \frac{V^2}{R} \, (W)$$

DC 2-wire type:

$$R < \frac{V - 3.6}{5 - I} \, (k\Omega) \qquad P > \frac{V^2}{R} \, (W)$$

V_S: Power supply voltage (V)
I: Load current (mA)
P: Rated wattage of bleeder resistor
3.6 V is the rated residual voltage.

DC 2-wire type (EV series)

If a relay is connected as the load, confirm that the dropout voltage of the relay is sufficiently higher than the sensor's residual voltage of 3.6 V. (A 12 VDC relay cannot be activated.)

Protection circuits of DC 2-wire type (EV series)

- Since this sensor incorporates a short-circuit protection circuit (not applicable to M8 type), direct connection of the power supply to the sensor does not cause the sensor to break down; however, the sensor will not be able to perform detection. Connect the brown lead to the positive terminal of the power supply and the blue lead to the negative terminal.
- This sensor incorporates a reverse-polarity protection circuit. However, reverse connection of the power supply to the sensor without a load may damage the sensor.

Protection circuit of AC 2-wire type (EV series)

Note that the short-circuit protection circuit may not function when the power supply capacity is 85 VAC or less.

Dimensions

Shielded type

Type		DC 3-wire type				DC 2-wire type			AC 2-wire type		
Model		EZ-8M	EZ-12M	EZ-18M	EZ-30M	EV-108M	EV-112M	EV-118M	EV-108V	EV-12M	EV-18M	EV-30M
a	(mm)	17	23	20	30	27	36	36		33		
b	(mm)	7	7	7	7	9.5	6	6				
c	(mm)	36	39	41	51	46.5	52	52	55		57	
d	Body diameter	M8	M12	M18	M30	M8	M12	M18	M12		M18	M30
	Thread pitch	1	1	1	1.5	1						1.5
e	Width across flat (mm)	12	17	24	36	12	17	24	36			
	Nut thickness (mm)	3	4	4	5							
	Cable length (m)	2	2	2	2		2					
f	Outer diameter (mm)	4	4	6		5.5	5.5	5.5				
	Core wire	4 x 0.15 mm²		4 x 0.3 mm²		2 x 0.15 mm²		2 x 0.3 mm²				

Non-shielded type

Type		DC 2-wire type			
Model		EV-108U	EV-112U	EV-118U	EV-130U
a	Tip diameter (mm)	8.5	13.4	18	27.8
b	Tip length (mm)	5.5	8		
c	(mm)	28.5	36		
d	(mm)	9.5	6		
e	(mm)	46	52	54	
f	Width across flat (mm)	12	17	24	
	Nut thickness (mm)	3	4		
g	Cable length (m)	2	2	2	
	Outer diameter (mm)	3.5	5.0	5.5	
	Core wire	2 x 0.15 mm²		2 x 0.3 mm²	

EZ-18T

ES SERIES

Long-distance, Separate-amplifier Proximity Sensors

A detecting distance twice that of conventional proximity sensors. Wide range of sensor head types available.
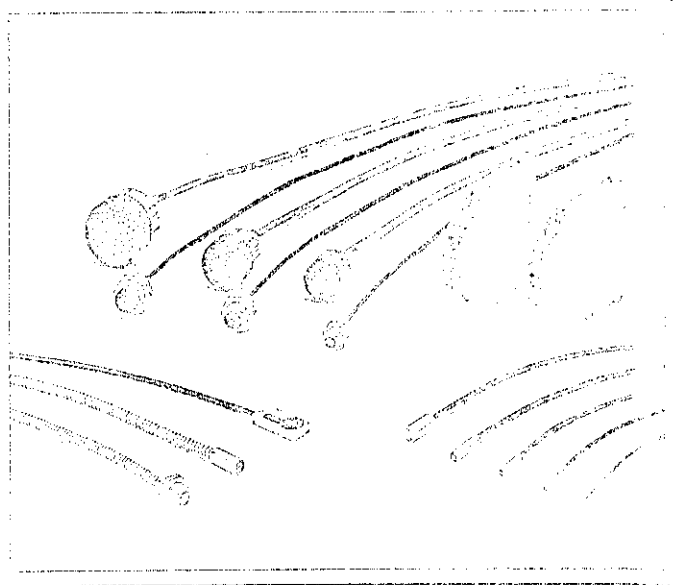
Features

Long detecting distance

By separating the electronic circuit from the sensor head the detecting distance of the ES series proximity sensor has increased to twice that of the self-contained proximity sensor.

Alarm output

The alarm output indicates a break in the sensor cable (ES-32DC) minimizing production line down time.

Detecting distance can be easily adjusted.

- The ES series eliminates the need for fine adjustments to sensor position during sensor setup. You can adjust the detecting distance using the trimmer on the amplifier after the sensor head is installed.
- The ES series has a small hysteresis, enabling detection of height difference for minute targets. The ES series can be used to count targets by detecting the minute unevenness of continuously moving objects.
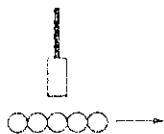
Dust cover (ES-X38)

The ES series is equipped with a dust cover to protect the amplifier and keep it clean. The dust cover is hinged so it remains on the amplifier when opened or closed.
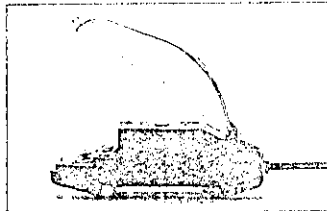
Sensitivity adjustment trimmer can be turned by hand. (ES-X38)

The sensitivity adjustment trimmer can turned by hand allowing quick adjustment when necessary.
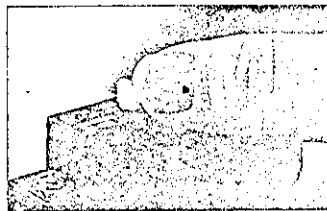
17 models of sensor heads available

Sensor heads are available in sizes ranging from 2.8 mm to 90.0 mm in diameter.

- Protected cable (EH-305S/306S/110S)
  The sensor cable is encased in a stainless steel spiral tube to prevent breakage from excessive bending or metal swarf generated by machining tool.

- Compact size, long detecting distance (EH-402)
  The smallest ES series proximity sensor, with a sensor head 2.8 mm in diameter, offers the maximum detecting distance of 7 mm.

- Space-saving (EH-614A)
  The ES series thin-type sensor is only 4.8 mm thick, enabling it to be installed in areas of limited space.

- Resistant to welding spatter (optional)
  The Teflon™ cap protects the sensor head (EH-308/110/114) from welding spatter.

- Oil-resistant (EH-108)
  Precision-machined stainless steel, and a special sealing mechanism makes the EH-108 highly resistant to oil.
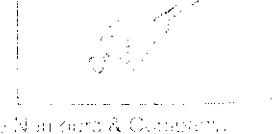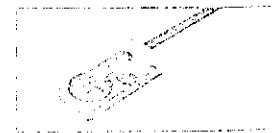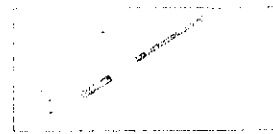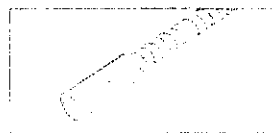
Teflon™ is a trademark of E.I. du Pont de Nemours & Company.

Applications
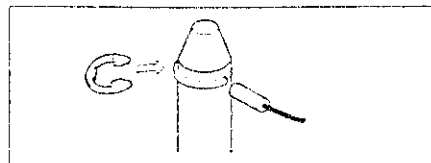
Detection E-ring insertion

A tiny E-ring can be stably detected with ES series. Even if the shaft which the E-ring is mounted on is made of metal, the ES series can detect the E-ring simply by adjusting the sensitivity.
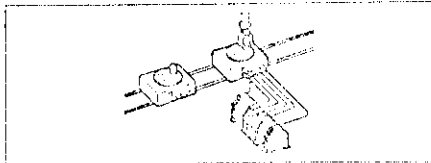
Checking of part ID affixed to pallet

The ultra-small cylindrical sensor head allows several sensor heads to be installed in a limited area. These sensor heads are adjusted for the same detecting distance by the respective controllers to form the sensor array.
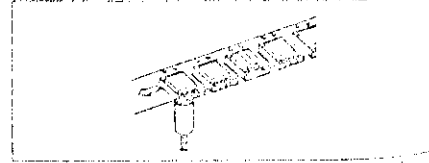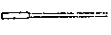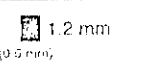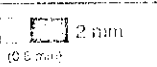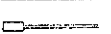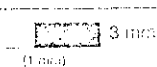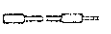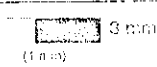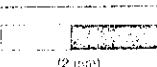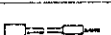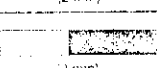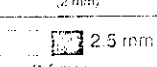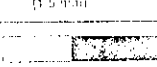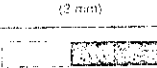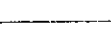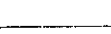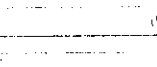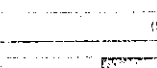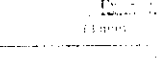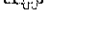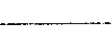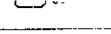
Determination of transistor placement

The ES series proximity sensor determines whether the transistor leads are placed firmly or floating by detecting the distance to the leads so that components that are not placed properly can be detected.

...ection Chart

...sor head

Type	Size	Shape	Detecting distance		Model
Cylindrical	2.8 mm dia.		☐ 1.2 mm (0.5 mm)	☐ Maximum detecting distance ☐ Stable detecting distance	EH-302
	3.8 mm dia.		☐ 2 mm (0.8 mm)		EH-303A
	5.4 mm dia.		☐ 3 mm (1 mm)		EH-305
Cylindrical, with spiral tube	5.4 mm dia.		☐ 3 mm (1 mm)		EH-305S
Cylindrical	8 mm dia.		☐ 5 mm (2 mm)		EH-308
Cylindrical, with spiral tube	8 mm dia.		☐ 5 mm (2 mm)		EH-308S
Threaded, oil-resistant	M8		☐ 2.5 mm (1.5 mm)		EH-105
Threaded	M10		☐ 5 mm (2 mm)		EH-110
Threaded, with spiral tube	M10		☐ 5 mm (2 mm)		EH-110S
Threaded	M14		☐ 8 mm (5 mm)		EH-114
Thin	t=4.8 mm		☐ 8 mm (5 mm)		EH-614A
Cylindrical	2.8 mm dia.		☐ 7 mm (3 mm)		EH-416
Cylindrical, threaded	14.5 mm dia.		☐ 13 mm (4 mm)		EH-416
	22 mm dia.		☐ 18 mm (8 mm)		EH-422
	30 mm dia.		☐ 25 mm (12 mm)		EH-430
	40 mm dia.		☐ 30 mm (18 mm)		EH-440
Cylindrical	90 m.m dia.		☐ 70 mm (50 mm)		EH-490

...plifier

Shape	Power supply	Output	Output mode	Model
	10 to 28 VDC	NPN open-collector 200 mA (40 V) max.	N.O./N.C. selectable	ES-0250
	85 to 115 VAC	Thyristor output 115 VAC, 5 to 300 mA	N.O./N.C. selectable	ES-1250
	12 to 24 VDC	NPN open-collector 100 mA (40 V) max.	N.O./N.C. selectable	ES-
	85 to 240 VAC	Thyristor output 240 VAC, 5 to 300 mA	N.O	
			N.O	

...his product does not comply with EMC directive.

Specifications

Sensor head

Type	Shielded							
	Cylindrical				Threaded		Thin	Oil-resistant
Model	EH-302	EH-303A	EH-305	EH-309	EH-110	EH-114	EH-614A	EH-108[1]
Stable detecting range	0 to 0.6 mm	0 to 0.8 mm	0 to 1 mm	0 to 2 mm			0 to 5 mm	0 to 1.5 mm
Maximum detecting distance	1.2 mm	2 mm	3 mm	5 mm			8 mm	2.5 mm
Detectable object	Ferrous metals (see Characteristics for nonferrous metals)							
Standard target (iron, t=1 mm)	5 x 5 mm				10 x 10 mm		15 x 15 mm	10 x 10 mm
Repeatability	0.002 mm				0.005 mm			
Hysteresis	0.04 mm	0.05 mm			0.04 mm		0.05 mm	0.07 mm
Temperature fluctuation	±10% max. of detecting distance at +23 °C (-10 to +60 °C) (EH-302: -10 to +20 °C)							
Enclosure rating	IP-67							
Ambient temperature	-10 to +60 °C							
Relative humidity	35 to 85%							
Weight (including nuts and 3-m cable)	Approx. 29 g	Approx. 38 g	Approx. 45 g	Approx. 47 g	Approx. 55 g	Approx. 62 g	Approx. 57 g	Approx. 51 g

1. Not designed for immersed use.

Type	Shielded; Spiral tube			Non-shielded					
	Cylindrical		Threaded	Cylindrical	Cylindrical and threaded				Cylindrical
Model	EH-305S	EH-309S	EH-110S	EH-402	EH-416	EH-422	EH-430	EH-440	EH-280
Stable detecting range	0 to 1 mm	0 to 2 mm		0 to 3 mm	0 to 5 mm	0 to 9 mm	0 to 13 mm	0 to 15 mm	0 to 35 mm
Maximum detecting distance	3 mm	5 mm		7 mm	13 mm	18 mm	25 mm	35 mm	70 mm
Detectable object	Ferrous metals (see Characteristics for nonferrous metals)								
Standard target (iron, t = 1 mm)	5 x 5 mm	10 x 10 mm		10 x 10 mm	20 x 20 mm	25 x 25 mm	30 x 30 mm	45 x 45 mm	150 x 150 mm
Repeatability	0.002 mm	0.005 mm		0.002 mm	0.012 mm	0.02 mm	0.035 mm	0.07 mm	0.35 mm
Hysteresis	0.05 mm	0.04 mm		0.01 mm	0.05 mm	0.05 mm	0.08 mm	0.1 mm	1.1 mm
Temperature fluctuation	±10% max. (EH-402: +20%, -10% max.) of detecting distance at +23 °C (-10 to +60 °C)								
Enclosure rating	IP-67								
Operation temperature	-10 to +60 °C								
Relative humidity	35 to 85%								
Weight (including nuts and 3-m cable)	Approx. 76 g	Approx. 88 g	Approx. 100 g	Approx. 26 g	Approx. 72 g	Approx. 175 g	Approx. 225 g	Approx. 350 g	Approx. 650 g

Amplifier

| Type	DC		AC		
Model	ES-32DC	ES-X33	ES-12AC[1]	ES-11AC[1]	ES-21AC[1]
Power supply	10 to 28 VDC Ripple (p-p): 10% max.	12 to 24 VDC Ripple (p-p): 10% max.	85 to 115 VAC 50/60 Hz	95 to 110 VAC 50/60 Hz	
Current/power consumption	18 mA max.	25 mA max.	(1.5 VA max.)	(5 VA max.)	
Response time	1 ms max.		10 ms max.		
Temperature fluctuation	±8% of detecting distance at +23 °C (0 to +50 °C)				
Sensitivity adjustment	By 15-turn trimmer				
Operation mode	N.C./N.O. (switch selectable)			N.C.	N.O.
Indicator	Output: Red LED				
Control output	NPN open-collector: 200 mA (40 V) max. Residual voltage: 1 V max.	NPN open-collector: 100 mA (40 V) max. Residual voltage: 1 V max.	Thyristor 115 VAC, 5 to 300 mA	Thyristor 240 VAC, 5 to 300 mA	
Disconnection alarm output	NPN open-collector: 100 mA (40 V) max. Residual voltage: 1 V max.		---		
Leakage current (OFF time)	---		0.2 mA max.		
Ambient temperature	0 to +50 °C				
Relative humidity	35 to 85%				
Weight	Approx. 48 g	Approx. 67 g (including 2-m cable)	Approx. 80 g	Approx. 120 g	

1. This product does not supply a built-in N.C. circuit.

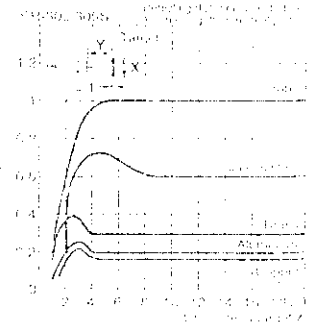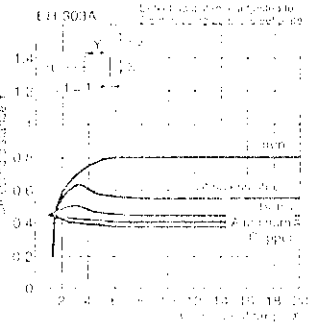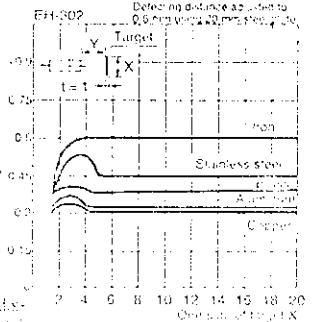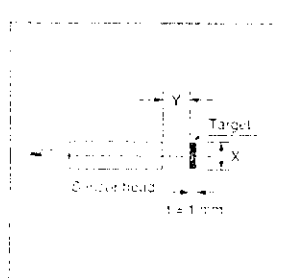## Characteristics

Detecting range (Typical)

Unit: mm
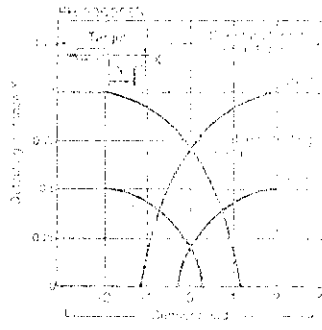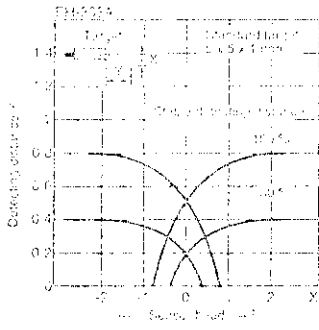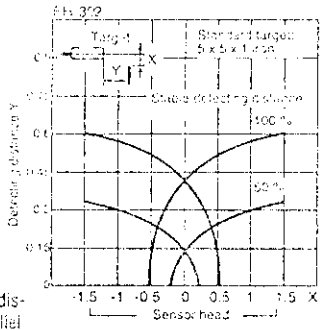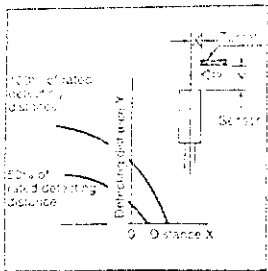
These graphs show variations in detecting distance measured by moving the target parallel to the sensor head for a distance 50% and 100% of the stable detecting distance. The target used is specified in each diagram.
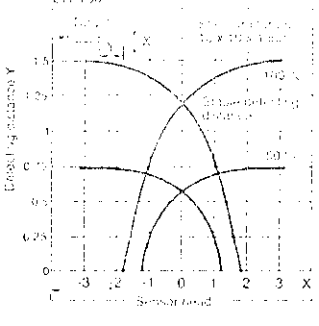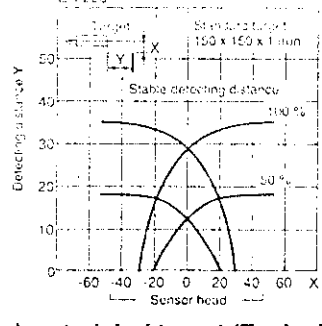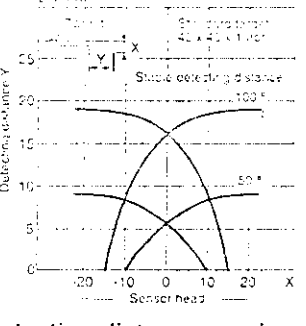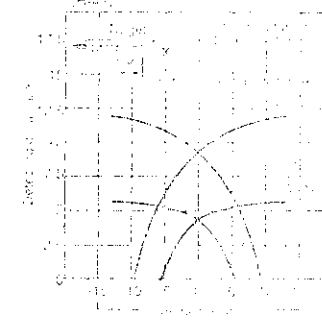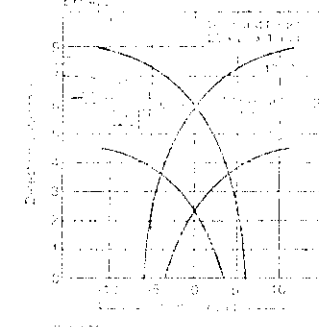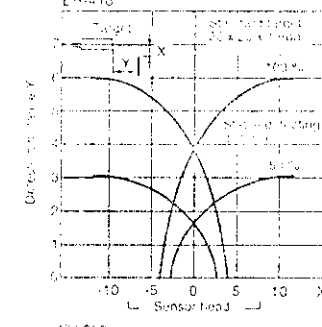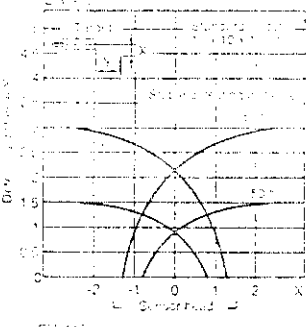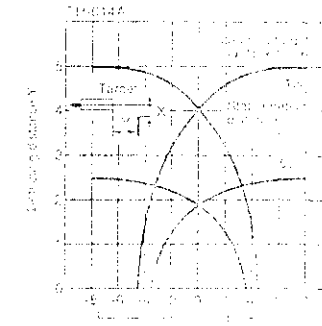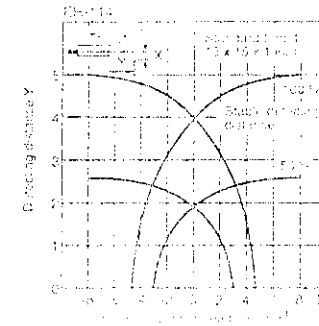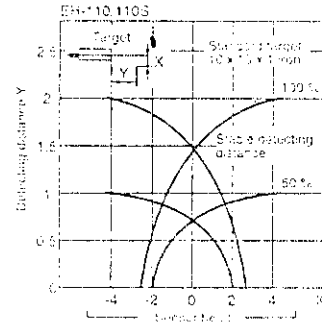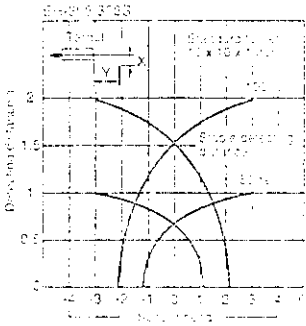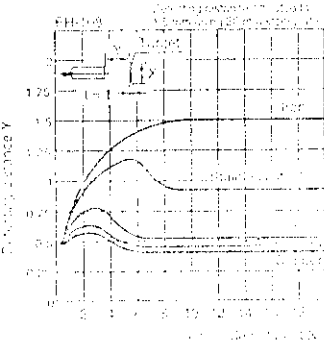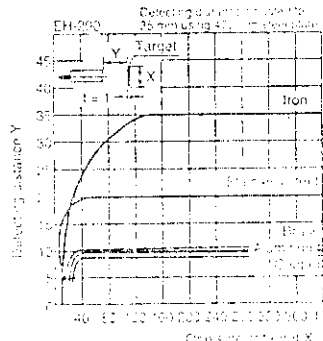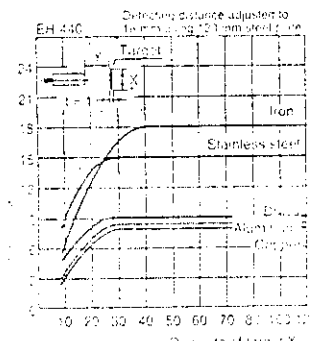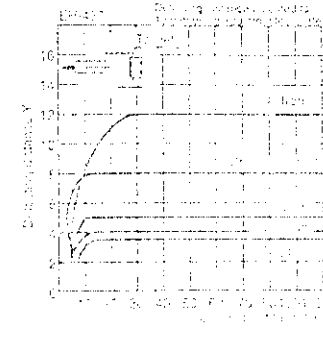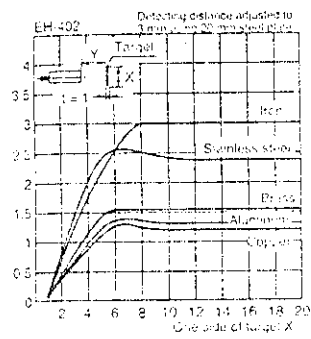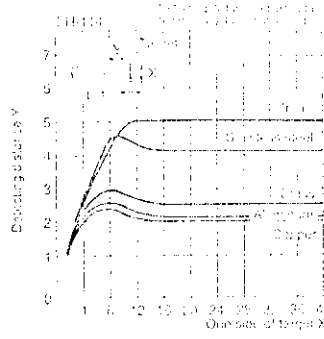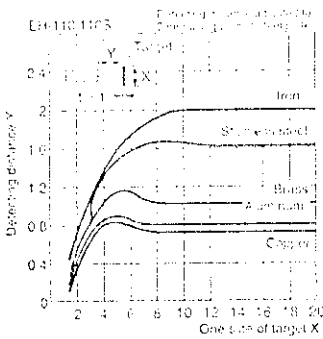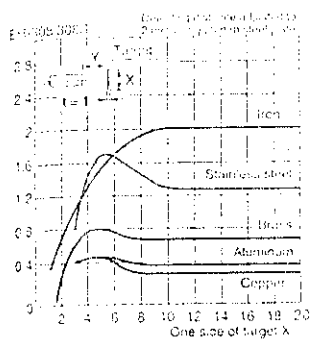
Detecting distance vs. size and material of target (Typical)

These graphs show variations in detecting distance Y (mm) obtained by using square metal plates (X × X × 1 mm, where X is varied) after adjusting the detecting distance of the sensor head to a stable detecting distance using the standard target.
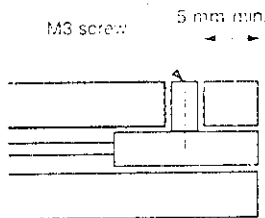
tecting distance vs. size and material of target (Typical)
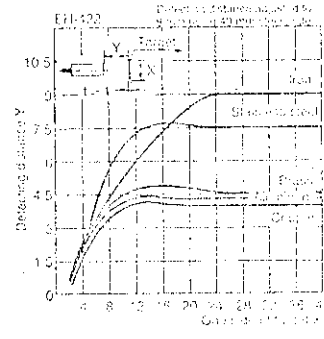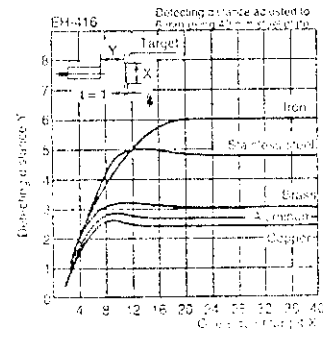
ints on Correct Use

ounting

Cylindrical type
Secure the sensor head with a screw at a position 5 mm or more from the tip of the head. (Tightening torque: 2 Nm (2 kgf•cm) max.)

M3 screw   5 mm min.

Threaded type
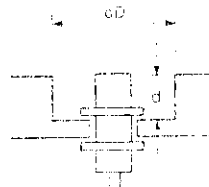When mounting the threaded-type sensor head, do not tighten beyond the torque specified in the following table.

Model	Tightening torque
EH-108	8 Nm (approx. 80 kgf cm) max.
EH-110	10 Nm (approx. 100 kgf cm) max.
EH-114	20 Nm (approx. 200 kgf cm) min.
EH-416	
EH-422	
EH-420	10 Nm (approx. 100 kgf cm) max.
EH-440	

Wiring
Use a high-frequency coaxial cable to connect the sensor head to the amplifier. Limit the length of extension to within 10 m (3 m for the EH-302 and EH-402).

Surrounding metal
Shielded-type sensors can be flush-mounted in metal. Sensors of the non-shielded type, however, should be mounted as per the guidelines given below in order to minimize the interference of the surrounding metal.

| Model	D (mm min.)	d (mm min.)
EH-402		
EH-416		
EH-434		
EH-410		
EH-440		
EH-420		

Interference

When installing 2 or more sensors of the same model face-to-face or in parallel, separate by the distance specified in the following table to prevent interference.

Distance / Model	Face-to-face (mm min.)	Parallel (mm min.)
EH-302	2 (1)	No space required
EH-303A	2 (1)	No space required
EH-305(S)	5 (3)	No space required
EH-308(S)	10 (7)	No space required
EH-110(S)	7 (4)	35 (no space required)
EH-114	11 (6)	39 (no space required)
EH-614A	11 (6)	64 (no space required)
EH-402	53 (12)	23 (11)
EH-416	11 (7)	115 (no space required)
EH-422	28 (9)	122 (no space required)
EH-430	41 (14)	250 (no space required)
EH-440	38 (29)	300 (no space required)
EH-108	7 (4)	No space required

Note: The above figures apply when the trimmer is turned to its optimal position for stable detection. The figures in parentheses apply when an optional interference prevention adapter is connected parallel to the sensor head (Except for ES-X38). Contact KEYENCE for further information.
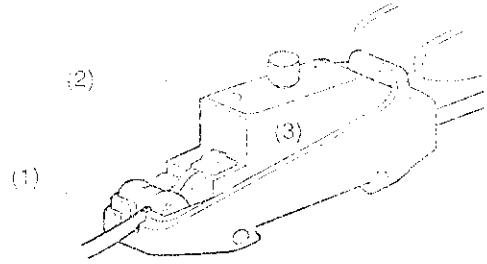
Amplifier unit (ES-X38)
Sensor cable end treatment

Shield

← 8 → ← 6 → ← 10 →
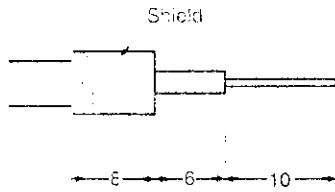
- Fold back the shielded cable over the sheath.

Sensor cable connections

To connect the sensor cable, insert the end of the cable through the entry port (1), tighten the screw (2), connect the core wire to the terminal (3), and then tighten the screw (3).

(2)
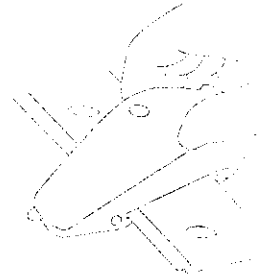(3)
(1)

- For connections to the EH-422/400/440/200, contact KEYENCE for more information.

Mounting/dismounting the amplifier unit on DIN rail or mounting bracket

Hook the rear of the amplifier unit on the DIN rail. Push the amplifier unit forward to hook the front of the unit.
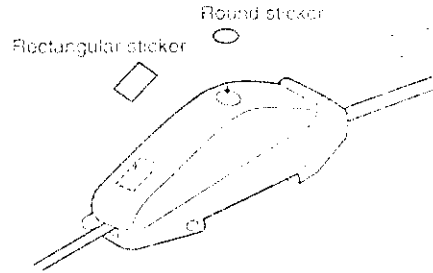
To dismount the amplifier unit, push the unit forward and then lift up the front of the unit.

How to use the attached sticker

Write the sensor number on the rectangular sticker and place it on the dust cover.
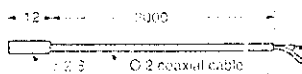Stick the round sticker over the round cover to ensure any adjustment trimmer setting should not be changed.

Round sticker
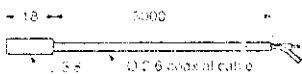Rectangular sticker

Dimensions

Sensor head

Unit: mm

EH-302

O.2 coaxial cable

EH-303A

O.2 coaxial cable

EH-305

O.2 coaxial cable
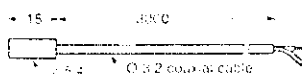
EH-305S
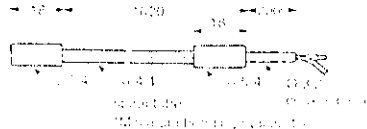
EH-308

EH-308S
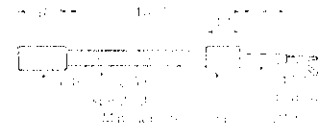
EH-108

Specifications

Amplifier

Model		TA-340
Sensitivity adjustment		By sensitivity selector switch and fine-adjustment trimmer
Control output (One-shot)	Solid-state[1]	NPN Open-collector: 100 mA 40 V max. Voltage output: L: 0.5 V max. (when object is detected) H: 12 V (when object is not detected) One-shot[2] Output resistance: 4.7 kΩ
	Relay contact	DPST 250 VAC 2 A, One-shot[2]
Output response time	Solid-state	1 ms
	Relay contact	10 ms
OFF-delay time		65 ms (contact output only)
Power supply		110/120/220/240 VAC ±10%, 50-60 Hz
Power consumption		5 VA max.
Ambient temperature		0 to +50 °C
Relative humidity		35 to 85%
Vibration		10 to 55 Hz, 1.5 mm double amplitude in X, Y, and Z directions, 2 hours respectively
Weight		Approx. 330 g
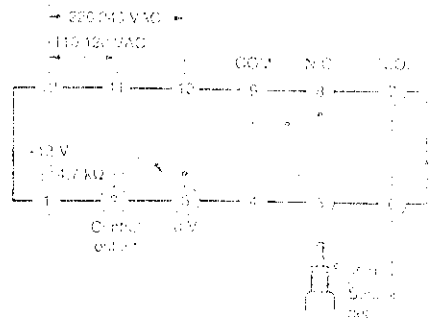
1. NPN output can easily be converted to PNP output by connecting the optional OP-5148 PNP Output Converter.

2. Control output: Both the solid-state and contact outputs of the amplifier are one-shot signals; the signals turn on as the object enters the sensor head.

Connections

TA-340

Dimensions

Sensor head (with 3-m coaxial cable)

Unit: mm

TH-305

TH-310

TH-315

TH-320

TH-105

TH-107

TH-110

TH-515

TH-520

Amplifier
TA-340