Low Cost Automation of Shearing Machine

P-277

Project Report

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In partial fulfilment of the requirements for the award of the degree of BACHELOR OF ENGINEERING in ELECTRICAL AND ELECTRONICS ENGINEERING Branch of Bharathiar University Coimbatore

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CERTIFICATE

This is to certify that the Project Report entitled

LOW COST AUTOMATION OF SHEARING MACHINE

has been submitted by

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in partial fulfilment for the award of the degree of
Bachelor of Engineering in Electrical & Electronics Engineering Branch
of the Bharathiar University
During the academic year 1996-97

9/4/97

Guide

Professor and Head

Certified that the Candidate with University Register No.________________ was examined by us in Project Work Viva-Voce Examination held on ____________

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No. SJEI/96-97 Date 24.03.97

TO WHOMSOEVER IT MAY CONCERN

This is to certify that the following final BE Electrical & Electronics Engineering students from **Kumaraguru College of Technology**, Coimbatore - 641 006 have completed their project in our organisation from July'96 to March'97.

1. **Mr.K.KAMALAPATHI**
2. **Mr.S.MANIVASAGAM**
3. **Mr.S.THOMAS GEORGE**
4. **Mr.V.BASKAR**

The title of the project was **"Low cost Automation of Shearing Machine"**.

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

We wish them the very best for a bright future.

For Sri Jai Lakshmi Engineering Industries

(R. RAMAMURTHY)
Partner

ACKNOWLEDGEMENT

We express our heartful thanks to our guide **Mr. G. SREEKUMAR M.E.,** *Lecturer in Electrical and Electronics Engineering, whose inspiration, unfailing enthusiasm and endless support helped us to work in a dedicated and consistent manner and complete this project successfully.*

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We also extend our thanks to all the staff members who have been helpful in completing this project.

SYNOPSIS

The productivity of an industry can be increased by reducing the unnecessary time delay in the production and the cost of production can be reduced by automising the operations of the machine. This project deals with low cost automation for the measuring section of a sheet cutting shearing machine.

In a shearing machine one surface is static and the other surface which is a blade is movable. Due to this shearing operation, the process of cutting the metal sheet is done. The dimension of the metal sheet to be cut is decided by an interconnected parallel back gauging system. The measuring back gauge assembly is mounted on to the machine at its back side. This back gauge assembly is moved according to the dimension of the sheet required. The metal sheet to be cut is fed manually from the front side and pushed until it hits the back gauge assembly. It is cut by the movable blade when a pedal provided at the corner of the machine, is pressed.

The manual positioning of this back gauge requires a lot of time and processing. This project enables easy positioning of back gauge and makes the operation of the machine very simple. The positioning of the back gauge is done by a drive coupled with a gear box. The drive used here is a 3 phase induction motor. The drive can be made to rotate either in clockwise direction (or) in anticlockwise direction. The direction and the duration of rotation of the drive is controlled by a microprocessor.

The proposed automation system is designed, fabricated and tested.

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INTRODUCTION

With the advent of automatics, time and work load for manufacturing the products has been considerably reduced.

AUTOMATION is the fast developing field in industries which has enabled industries to reach the present smashing rate of production. In future automation has a very great role to play in the industries.

1.1 SHEARING MACHINE AND ITS PROCESS

This machine involves cutting of large metal sheets, which are used for various purposes. The process of shearing involves sliding of one surface over the other. During this process the metal sheet of required dimensions to be cut is fed to the machine. This involves higher manual care and alertness. The arrangement for shearing is done with a static table edge and a moving blade. This moving blade slides over the table edge and the blade cuts the metal sheet.

1.2 NEED FOR AUTOMATION

Since the feeding and measurement process are done manually, the chances of error is very high. As we are in need of precise measurements the need for accuracy arise. This accuracy can be achieved by automation. The manual operation is a time consuming one. This type of time delay can be avoided by automation. The automation involves the use of microprocessor and a sensing device. They sense the movement of back gauge by producing a particular number of pulses per rotation of the motor. The produced pulses are counted by the microprocessor to interpret the exact position of the backgauge and to give commands to relay for further movement and positioning.

The use of microprocessor helps to get accuracy in a very good manner and the components used in this project costs low. Hence the aim of the project is achieved.

1.3. ADVANTAGES OF AUTOMATION

This automation process reduces the work load for men and allows the labour to do some other useful work instead of wasting time in adjusting and positioning the backgauge. This reduces the fatigue of the workers both physical and mental. The operator is freed from direct participation in the adjustment of the measuring section. Thus accuracy is precisely obtained. The time delay in the operation is reduced. Hence the productivity is achieved in an efficient manner. The number of employees involved is reduced. Hence this project satisfies the aims of low cost automation.

1.4 MODULES OF THE PROJECT

This project involves the use of feedback circuit, control circuit and a power circuit. The feedback circuit gets the sensed signal and pass it to the control circuit. This results in the operation of microprocessor which enable the power circuit to be switched on or off accordingly. The feedback circuit involves the use of proximity switches, optocoupler and toothed disc. The power circuitry involves the use of the electromagnetic contactors, MOSFET, overload relays. The 3 phase induction motor with gear box constitute the driving mechanism. The control circuitry involves the use of a microprocessor and optocoupler. The details of these circuits are explained later.

CHAPTER 2

THE SHEARING MACHINE

2.1 INTRODUCTION

The cutting of large metal sheets cannot be done manually, since it is time consuming and very difficult. A shearing machine is used to cut large steel sheets (here maximum 8mm thick).

The machine cuts the sheets by the process of mechanical shearing. Shearing is a process of one surface sliding over the other. Here one surface is the table edge and other one is the moving blade which will shear over the table edge. When a metal sheet is kept adjacent to the table edge, the moving blades shears over it and required dimension of the sheet is cut.

2.2 DRIVING MECHANISM

The moving blade is driven by a 15 HP 3 phase induction motor mounted on one of the top corner of the machine. The speed is reduced in a gear train and the rotary energy is given to the blade for its movement.

The motor can be switched on and off by a 3 phase starter provided on the side of the machine. The speed of the main motor is constant and cannot be altered.

2.3 METAL FEEDING SECTION AND MEASUREMENT

The metal sheet has to be fed from the front side. For measurement the parallel back gauge is provided at the back end of the feeding. The back gauge is driven manually by a screw driving mechanism. The back gauge is moved to the required distance by rotating the shaft of the screw mechanism. After the back gauge has been moved to the distance required the sheet is pushed from the front side until it makes contact with the adjusted back gauge. Then the motor is started and blade shear over the sheet and cut is performed accurately.

2.4 TECHNICAL DETAILS OF SHEARING MACHINE

Side frames : Are of solid steel plates designed for maximum rigidity to eliminate deflection and to withstand continuous high speed performance at full capacity.

Bed or Table : Is of closed box type construction, which forms a rigid backbone for the shear and a solid backing for the lower knife. Additional ribs under the table adds to its strength.

Cutter Beam : The ram is of solid steel plates accurately machined. The ram brace is bolted to the ram to adjust the camber which may result after long use. The ram moves in taper guides. This facilitates easy adjustment of clearance between Ram and table for cutting various thickness. Counter balance springs are provided in over crank shearing machines of above 1250 x 8 mm capacity to counter act the weight of the ram and ram brace thus giving smooth shearing action.

Crank shaft : Is of forged carbon steel accurately machined and runs in gun metal bushes. Fly wheel shaft runs in ball bearings.

Hold Down : Steel fabricated and is used for clamping the plate securely to the table while being cut. Spring loaded mechanical hold down is provided in all machines. However in machines of 6 mm capacity and above, pressure arms fitted to the cross support are provided for additional grip, before cutting.

Hydraulic Hold Down : Hydraulic hold down can be provided in over crank shearing at extra-cost. It maintains pressure along the full length of the work piece, preventing slippage. Provision is kept for adjusting hydraulic pressure. The pressure of each hold down nut is ample to securely hold even a short piece which comes under only one hold down plunger.

Blades : Four edged HC blades are provided.

Rolling Key Clutch : Made of alloy steel for positive engagement and continuous operation having three key way in the EN-8 insert.

Brake : Constant spring adjustable brake is provided.

Gauges : Rigid and accurate construction of back gauge provides consistent width of sheet to be cut.

2.5 TECHNICAL SPECIFICATIONS

MODEL	:	OC/2500-8
MAXIMUM THICKNESS IN (mm)	:	8 mm
MAXIMUM LENGTH OF CUT IN (mm)	:	2500 mm
LENGTH BETWEEN HOUSING IN mm	:	2750 mm
DEPTH OF GAP IN FRAME	:	100 (mm)

NUMBER OF STROKES PER MINUTE	:	50
CUTTING ANGLE (OR) SHEARING ANGLE	:	$2^\circ 30'$
MAX BACK GAUGE ADJ (mm)	:	600 mm
MAXIMUM MOTOR HP	:	15 HP
CAPACITY OF MACHINE	:	80 tonnes

CHAPTER - 3

THE AUTOMATION PROCESS

3.1 INTRODUCTION

The automation of shearing machine requires a 3 phase induction motor, shaft attached with a gear box. The direction of rotation of the induction motor depends on which relay contact is closed.

The scheme consists of a power circuitry, a control circuitry, and a feed back circuitry. The power circuitry is built up of coil of relays. The control circuitry consists of the microprocessors 8085 which generates the control signals. An opto isolator is also used to electrically isolate the microprocessor from the power circuitry and from the feed back circuitry.

The power MOSFET in the power circuitry can be switched on by the control circuitry. The feed back circuitry consists of sensor which gives the pulsed input to the microprocessor as the information of number of rotation of motor shaft. The overall block diagram of the scheme is shown in Fig. 3.1. It consists of a micro processor, opto isolator, power circuitry, power supply and a sensor.

3.2 POWER CIRCUITRY

In the power circuitry power semiconductor devices like thyristors, GTOS, power transistors and power MOSFETS, are generally used. These devices must be capable of handling large power and must be capable of being operated into inductive loads.

By considering factors like voltage, current, frequency and also the cost of the device, Power MOSFETS can be used in the power circuitry as a switching device. It is faster in operation and hence can be operated at high frequencies. Also it is possible to eliminate the voltage and current amplification stages that are required when power transistors are used as the switching devices. Thus the control circuitry becomes simple.

I. POWER MOSFET

A power MOSFET is a voltage controlled device and requires only a small (or) negligible gate current at the steady state. The switching speed is very high and the switching times are of the order of nano seconds. MOSFETs do not have the problems of second breakdown phenomena as do BJTs.

However MOSFETs have the problem of electro static discharge and requires special care in handling. In addition it is relatively difficult to protect them under short circuited fault conditions.

MOSFETs are of two types.

1. Depletion MOSFETs
2. Enhancement MOSFETs

MOSFET is a three terminal device. The three terminals are gate, drain and source. Power MOSFET will operate only when the gate is given the threshold voltage.

A n-channel enhancement type MOSFET shown in fig. has been made use of in this work since it has the advantage of responding only to a positive gate voltage.

II. STEADY STATE CHARACTERISTICS OF MOSFET

MOSFETs are voltage controlled devices and have very high input impedance. The gate draws a very small leakage current in the order of nano amperes. The steady state characteristics of an n-channel enhancement type MOSFET is shown in Fig. 3.4. There are three regions of operations.

1. Cut off region, where $V_{GS} \leq V_T$.

2. Pinch off (or) saturation region, where $V_{DS} \geq V_{GS} - V_T$.

3. Linear region, where $V_{DS} \leq V_{GS} - V_T$.

The pinch-off occurs at $V_{DS} = V_{GS} - V_T$. In the linear region, the drain current I_D varies in proportion to the drain source voltage, V_{DS}. Due to high drain current and low drain voltage, the power MOSFETs are operated in the linear region for switching actions.

iii. MOSFET AS A SWITCH IN POWER CIRCUITRY

MOSFETs are used in the power circuitry to energize the relay coil. It acts as a switch to turn ON and OFF according to the input from the microprocessor.

The working of the power circuitry is as follows : The power circuitry consists of two relays of 3 C/O whose coils are energised by two MOSFETs, and a 1/2 HP 3 phase induction motor. The relays are connected in the circuit in such a way that when the contacts of one relay is closed, the phase sequence of the three phase power supplied to the induction motor is RYB, and when the contacts of the other relay is closed, the phase sequence of the three phase power supplied to the induction motor is reversed (ie.) RBY and hence the direction of rotation of the motor.

The relays are actuated by the power MOSFETs, which acts as a switch. When a positive gate voltage is given to the MOSFET 1, the MOSFET 1 turns ON and hence the coil of the relay 1 is energised. So the phase sequence to the motor is RYB. On the other hand, when a positive gate voltage is given to the MOSFET 2, the MOSFET 2 turns ON energises coil of relay 2. Hence the phase sequence to the motor is RBY.

iv. PROBLEMS WITH POWER CIRCUITRY

MOSFETs requires certain turn ON and turn OFF times. During turn ON, the drain current I_D rises and if the rate of rise of drain current d_i/d_t is very fast compared to the spreading velocity of a turn-ON process, a localized hot spot heating will occur due to high current density and the device may fail, as a result of excessive temperature.

dv/dt : If a step voltage is applied across the drain and sources, the dv/dt may be high enough to turn ON the device. The dv/dt can be limited by connecting capacitor C_s. When MOSFET is turned ON, the discharge current of capacitor is limited by resistor R_s. With an RC circuit known as a snubber circuit, the voltage across the MOSFET will rise exponentially.

During turn ON, the drain current rises and the di/dt is

$$\frac{di}{d_t} = \frac{I_L}{t_r} = \frac{I_D}{t_r}$$

During turn OFF, the drain source voltage must rise in relation to the fall of the drain current, and dv/dt is

$$\frac{dv}{d_t} = \frac{V_s}{t_f} = \frac{V_{Ds}}{t_f}$$

Protection circuits are normally required to keep the operating di/dt and dv/dt within the allowable limits of MOSFET. The RC network across the transistor is shown as the snubber circuit (or) snubber and limits the dv/dt. The inductor L_S, which limits the di/dt is sometimes called a series snubber.

3.3 CONTROL CIRCUITRY

The control circuitry consists of a micro processor, and opto isolators. The microprocessors controls the excitation of the relay coils responding to the input signals from the sensors and to the input data that is given. It converts these signals into gate signals for the power MOSFETs in the power circuitry. The advantage of using a microprocessor based scheme are accuracy and good reproducibility.

NEED FOR ISOLATION OF GATE AND BASE DRIVES

The reasons are,

1. Control circuitry is designed to handle very low voltage and current, whereas the power circuitry handles higher current and voltage. So to avoid loading of control circuitry by power circuitry, we need isolation.

2. At the instant of faults (or) short circuit in the power circuitry, large current or voltage spikes will occur in that. If control circuitry is not isolated from power circuitry it will get affected with that disturbance and will get damaged.

There are two ways of floating (or) isolating the control (or) gate signal with respect to ground. They are

1. Pulse transformers
2. Opto couplers.

1. PULSE TRANSFORMERS

Pulse transformers have one primary winding and can have one (or) more secondary winding. Multiple secondary windings allow simultaneous gating signals to series and parallel connected transistors. Fig. 3.5 shows a transformer-isolated gate drive arrangement. The transformers should have a very small leakage inductance and the rise time of the output pulse should be very small. At a relatively long pulse and low switching frequency, the transformers would saturate and its output would be distorted.

2. OPTO COUPLERS

Opto coupler combines an infra red LED and a silicon photo transistor. The input signal is applied to the infra red LED and the output is taken from the photo transistors. The rise and fall times of photo transistors are very small with typical values of turn ON time t_{ON} = 2 to 5 us, and turn OFF time t_{OFF} = 300 ns. These turn ON and turn OFF time limits the high frequency applications. A gate isolation circuit using a photo transistor is shown in Fig. 3.6. The photo transistors require separate power supply.

Due to the transformer separation and the production of distorted output at low switching frequency and 10 ns pulse we go in for the opto coupler, to isolate gate and base drives.

3.4 FEED BACK CIRCUITRY

The feed back circuitry includes a sensor, an opto coupler and a teeth shaft. The sensor used in our project is inductive proximity switch. It is a 3 wire switch, operating on DC voltages from 10 to 30 v DC. They are available with NPN, PNP (or) a complementary output. We use NPN type. It senses the presence of any metal and the largest sensing ranges obtained with ferrous metals. The proximity switch produces the output pulse when the tooth of the shaft crosses the proximity switch.

3.5 POWER SUPPLY

The power circuitry requires a power supply which gives the required voltage and current for the relay coils. A fixed D.C. power supply is used for this purpose.

The general block diagram of the power supply is given in Fig. 3.8

The transformer steps down the voltage to the required level and also provides isolation. The rectifier converts this stepped down A.C. voltage into a pulsating D.C. voltage. The pulsating D.C. voltage is filtered by using a capacitor. It is regulated by a voltage regulator to get a regulated D.C. supply.

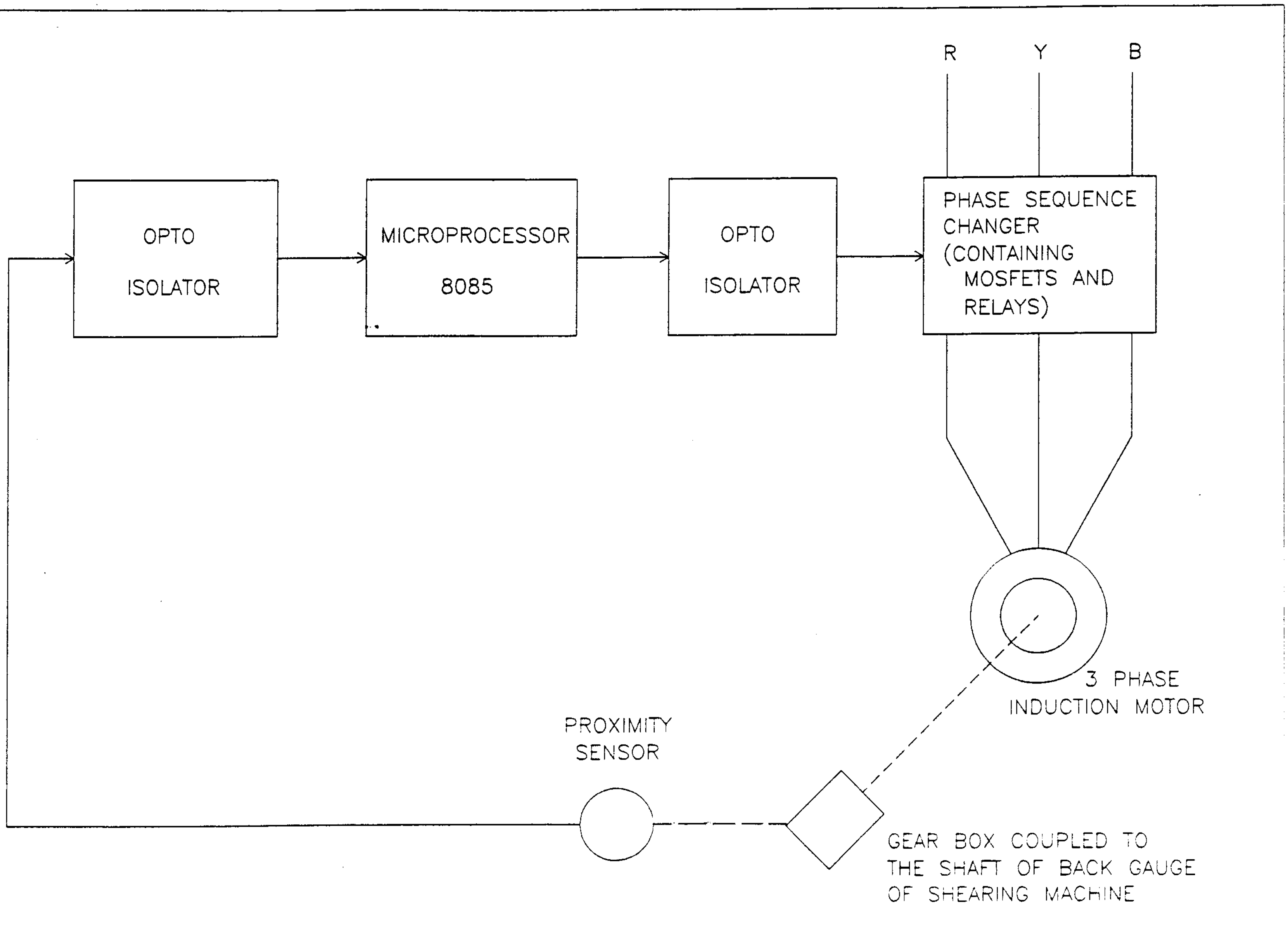


FIG-3.1 BLOCK DIAGRAM

(a) N-CHANNEL DEPLETION TYPE MOSFET:-

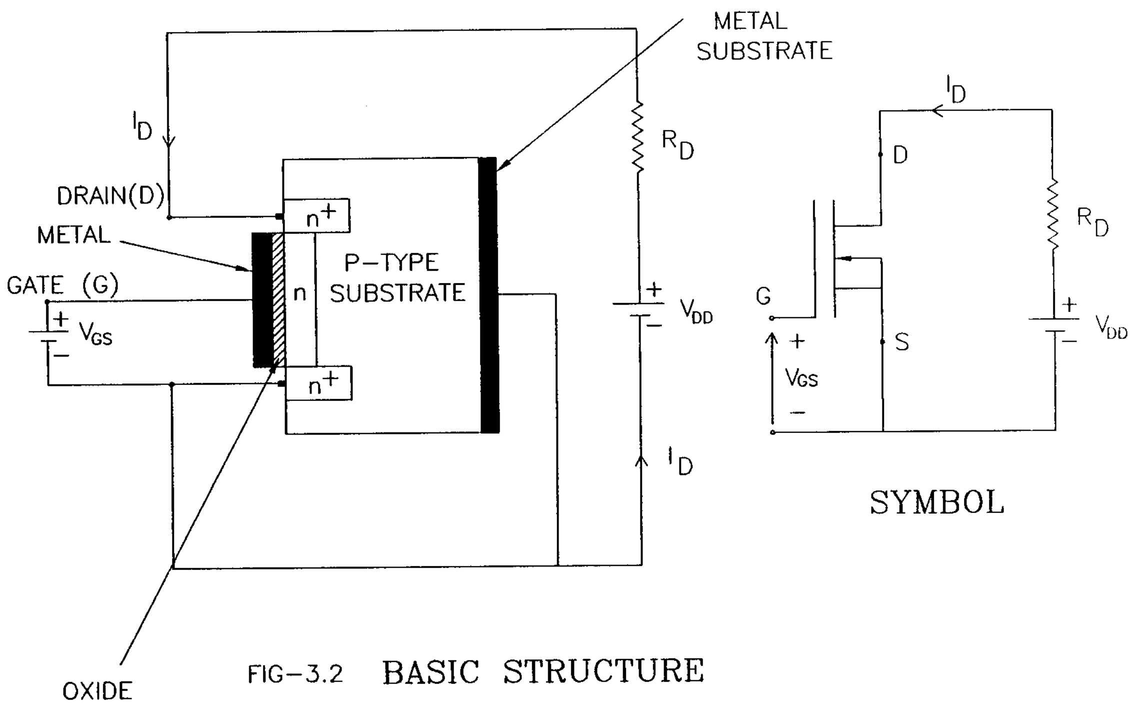


FIG-3.2 BASIC STRUCTURE

(a) N-CHANNEL ENHANCEMENT TYPE MOSFET:-

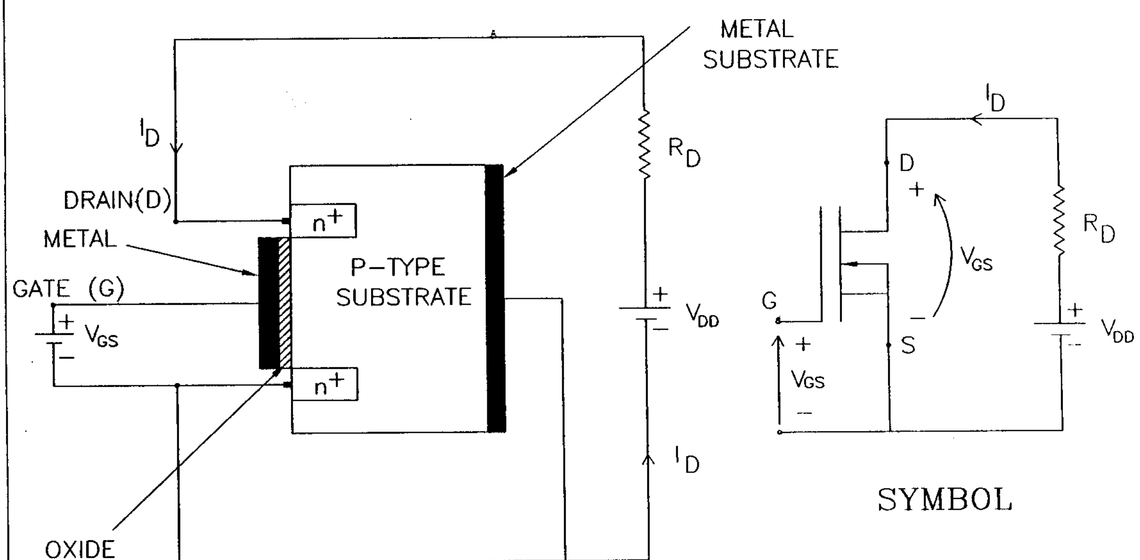


FIG-3.3 BASIC STRUCTURE

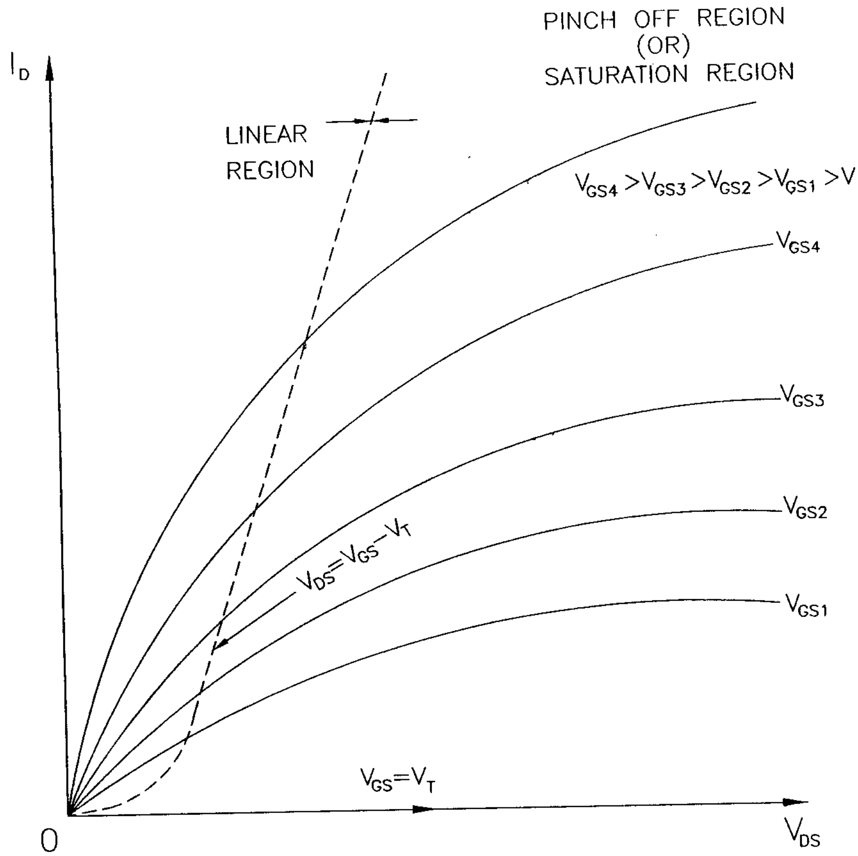
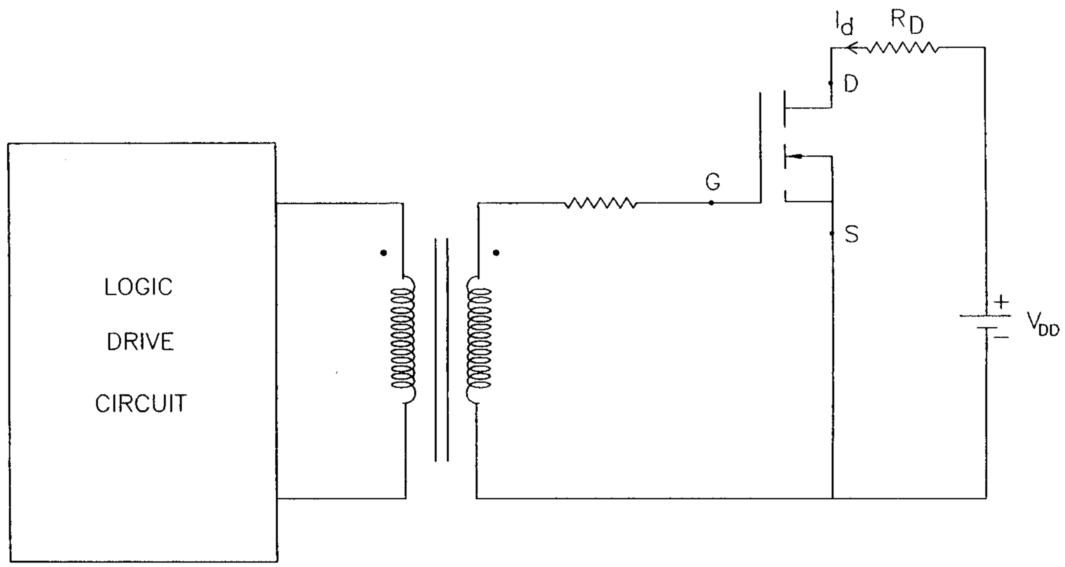


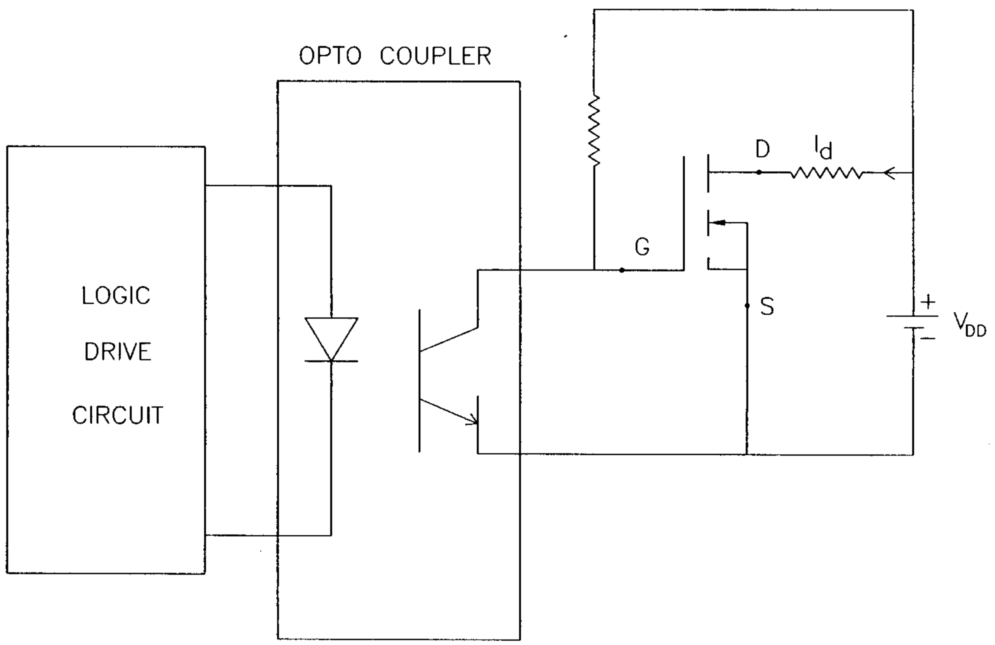
FIG-3.4 OUTPUT CHARACTERISTICS OF ENHANCEMENT TYPE MOSFET



FIG–3.5

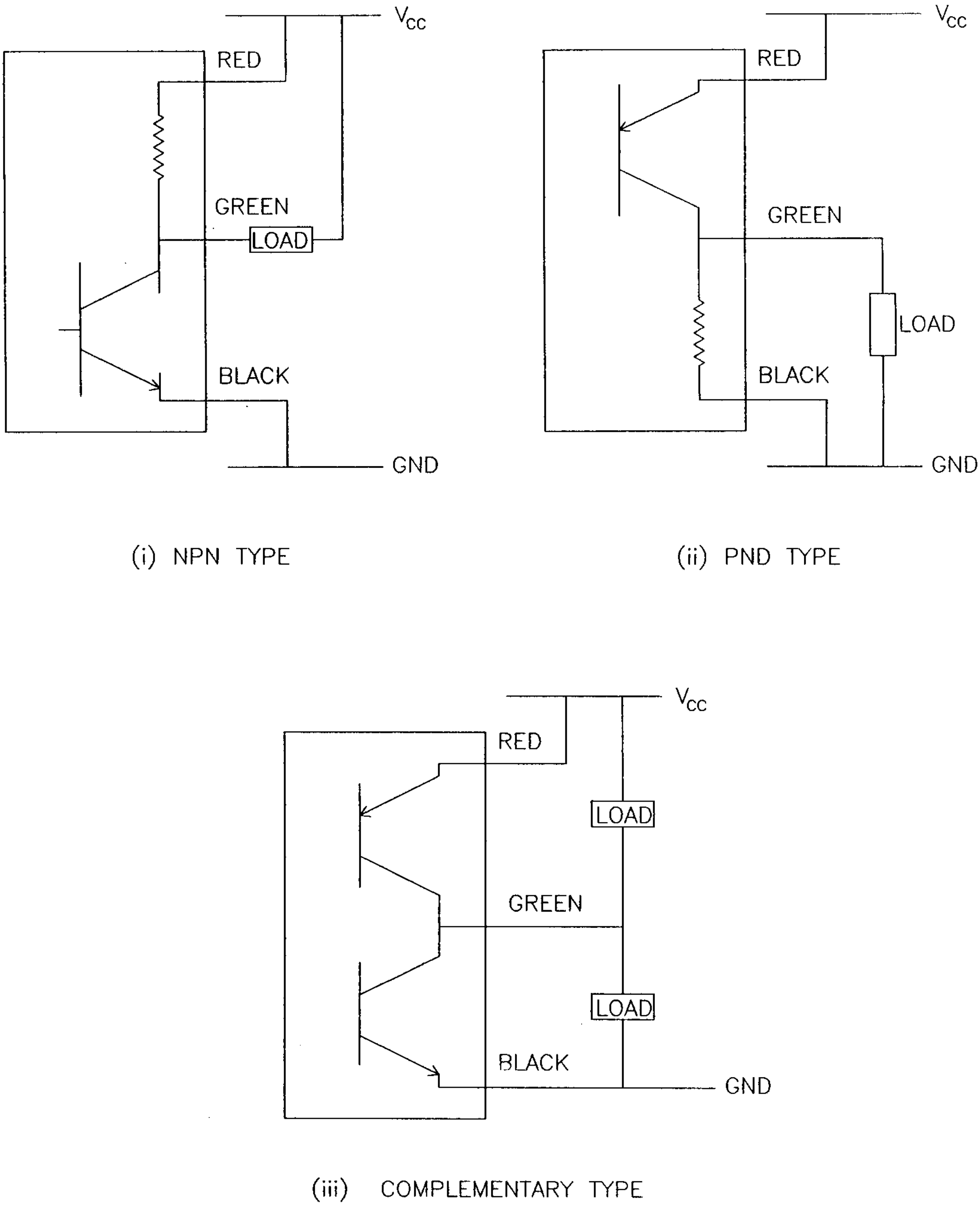
PULSE TRANSFORMER– ISOLATED GATE DRIVE ARRANGEMENT

OPTO COUPLER



FIG–3.6

OPTO COUPLER– ISOLATED GATE DRIVE ARRANGEMENT



Vcc
RED
GREEN
LOAD
BLACK
GND
(i) NPN TYPE
Vcc
RED
GREEN
LOAD
BLACK
GND
(ii) PND TYPE
Vcc
RED
LOAD
GREEN
LOAD
BLACK
GND
(iii) COMPLEMENTARY TYPE

FIG-3.7

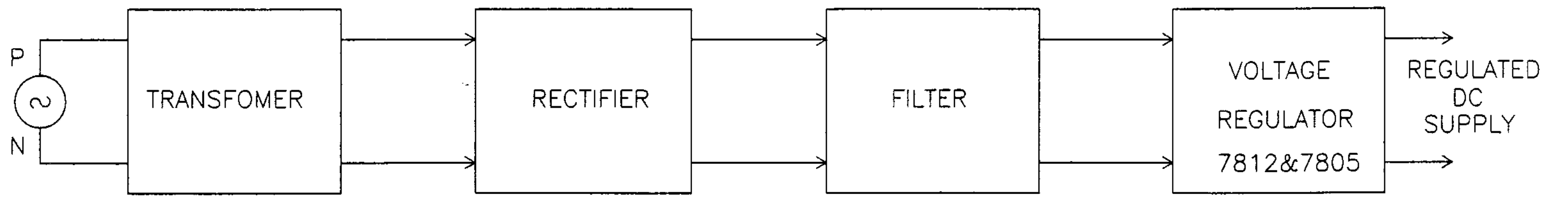


FIG-3.8 BLOCK DIAGRAM OF THE POWER SUPPLY

CHAPTER - 4

DESIGN AND DEVELOPMENT

4.1 DESIGN OF DRIVE MECHANISM

A microprocessor based scheme has been designed for the automation of shearing machine. The scheme consists of the following part/components.

A 3 phase induction motor with the following specification are used.

S.NO.	:	1419
VOLTAGE	:	440 V
PHASE	:	3 Ph
FREQUENCY	:	50 Hz
CURRENT	:	0.75 A
SPEED	:	1440 rpm
CAPACITY	:	1/2 hp

GEAR BOX

MODEL NO.	:	162
CAPACITY	:	1/2 hp
CONVERSION RATIO	:	1:20

4.2 DESIGN OF POWER CIRCUITRY

The power circuitry shown in fig. has been designed using power MOSFETs.

In this work, the power MOSFET IRF630 was chosen to satisfy the voltage and current ratings of the relays. The voltage and current ratings of MOSFET are 200 volts and 9A respectively.

4.3 DESIGN OF CONTROL CIRCUITRY

The control circuitry consists of the microprocessor 8085 and an opto-isolator.

The control signals for the power MOSFET in the power circuitry are generated by the microprocessor 8085. To get these control signal an assembly language program was written and given under the topic 4.8.

The opto isolator MCT2E is chosen to electrically isolate the microprocessor from the power circuitry. The voltage and current requirements of the LED of opto isolator are met by the output of 8085 processor. The photo transistor in the opto isolator is used to amplify the voltage from the microprocessor and is given to the gate terminals of the MOSFET.

4.4 DESIGN OF FEED BACK CIRCUITRY

The feedback circuit consists of an inductive proximity switch. The specification of the switch are

SIZE	:	M18
SUPPLY VOLTAGE	:	10-30 V DC
CURRENT CONSUMPTION	:	300 mA
HYSTERISIS	:	10%
VOLTAGE DROP	:	0.3 V max.
OPERATING TEMPERATURE	:	-20°C to 60°C
FUNCTION INDICATION	:	RED LED

MOUNTING	:	Non flush
OUTPUT LOGIC	:	Normally open
HOUSING	:	Chrome plated brass
NOMINAL SENSING DISTANCE	:	8 mm
SENSING DISTANCE CORRECTION FACTOR	:	
Fe	:	1.0
Chrome and Nickel	:	0.9
Brass	:	0.5
Al	:	0.4
OPERATING FREQUENCY	:	500 Hz
CABLE	:	0.3 x 0.34 sq. mm, 2m flying lead

4.5 DESIGN OF POWER SUPPLY

Power supply required for the power circuitry consists of a transformer 230v/12v to step down the A.C. voltage, diodes IN4001 for rectification, capacitors 1000 μF/25v for filtering and a voltage regulator 7812 for regulation are used.

The overall circuitry is designed and developed. It is shown in the Fig. 4.2.

4.6 DESIGN OF SNUBBER CIRCUIT

The turn ON di/dt is $di/dt = V_s/L_s$

$$= \frac{V_s}{L_S} = \frac{I_D}{t_r}$$

$$L_S = \frac{V_s t_r}{I_D}$$

$$= \frac{(12)\ (50 \times 10^{-9})}{0.06}$$

$$= 10\ uH.$$

The turn OFF dv/dt is $dv/dt = I_D/C_s$

$$C_S = \frac{I_D t_f}{V_S}$$

$$= \frac{(0.06)\ (40 \times 10^{-9})}{12}$$

$$= 0.2\ nF$$

$$R_S = 2 \frac{L_S}{C_S}$$

$$= 141.42\ ohm$$

4.7 COST ESTIMATION

The following table gives the cost of various electrical materials employed in the automation of shearing machine.

S. No.	Specification of material	Quantity Required	Rate Rs.	Rate P.	Per	Total cost Rs.	Total cost P.
1.	1/2 hp 3 phase Induction motor	1	1900	00	1	1900	00
2.	Gear box 1:20	1	5550	00	1	5550	00
3.	Proximity switch (inductive)	1	350	00	1	350	00

(Contd...)

(Contn...)

S. No.	Specification of material	Quantity Required	Rate Rs.	P.	Per	Total cost Rs.	P.
4.	Microprocessor SDA 8085 kit	1	5345	00	1	5345	00
5.	Transformer						
	i. 230 v/12v-0-12v	1	125	00	1	125	00
	ii. 230 v/6v-0-6v	1	30	00	1	30	00
6.	Integrated circuits						
	i. 7812	1	45	00	1	45	00
	ii. 7805	1	12	00	1	12	00
	iii. 7404 with base	1	11	00	1	11	00
7.	Electromagnetic relay (12V, 6A) with base	2	191	50	1	383	00
8.	Thermal overload relay (2A)	1	500	00	1	500	00
9.	ON-OFF switch	1	200	00	1	200	00
10.	MOSFET IRF 630	2	60	00	1	120	00
11.	Inductor (4.5 μH)	4	5	00	1	20	00
12.	Opto isolator MCT2E with base	3	15	90	1	47	70

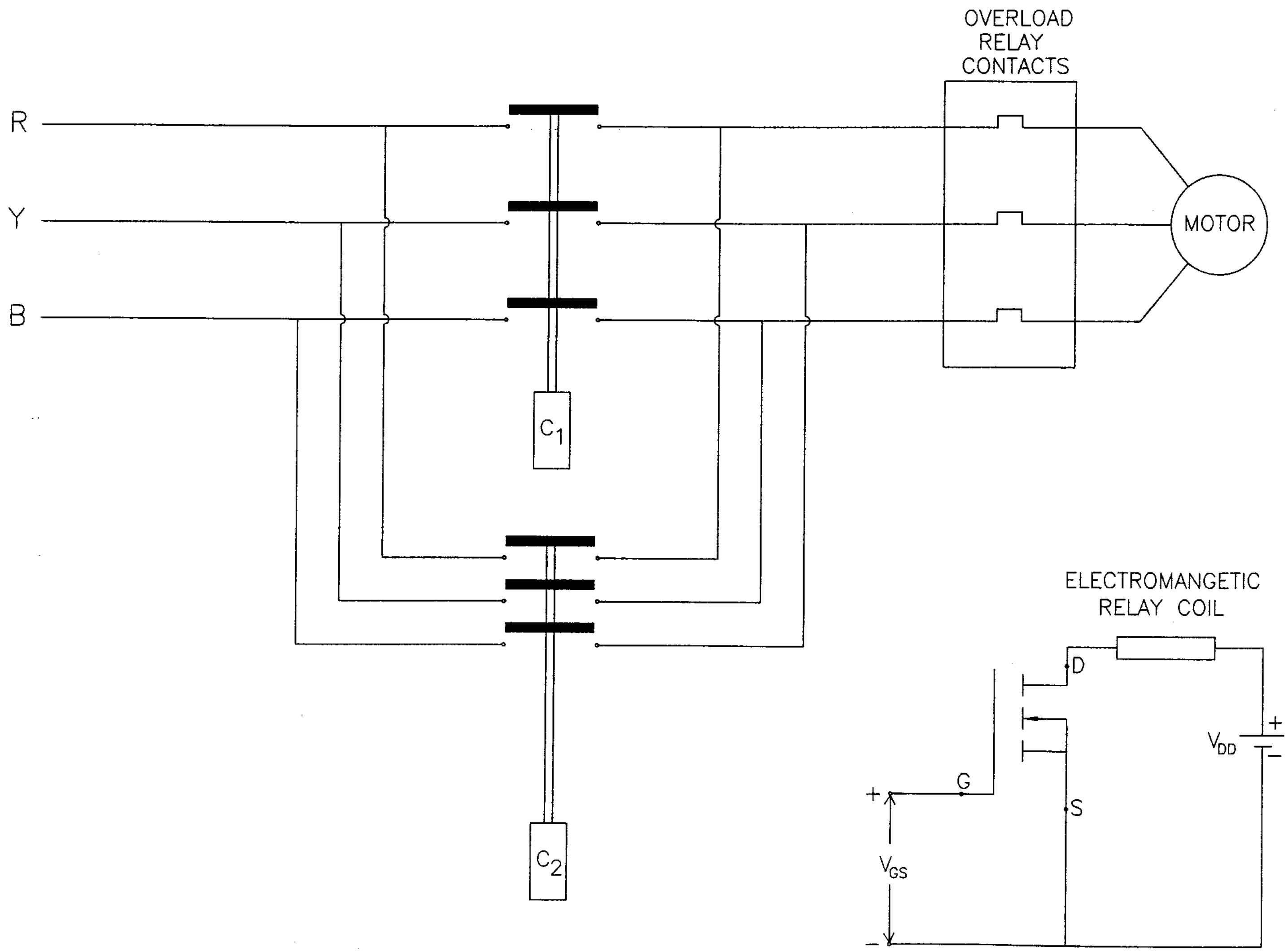
(Contd...)

(Contn...)

S. No.	Specification of material	Quantity Required	Rate Rs.	P.	Per	Total cost Rs.	P.
13.	Bridge rectifier	2	9	00	1	18	00
14.	Diode IN4001	4	0	50	1	2	00
15.	Capacitors						
	i. 1000 μF/25V	2	5	00	1	10	00
	ii. 0.33 μF/25V	1	2	00	1	2	00
	iii. 0.22 μF(disc)	2	2	00	1	4	00
	iv. 470 μF/25V	1	2	00	1	2	00
16.	Resistors						
	i. 220 Ω	3	0	30	1	0	90
	ii. 1 K Ω	4	0	30	1	1	20
	iii. 150 Ω	2	0	30	1	0	60
17.	Heat Sink	3	6	00	1	18	00
18.	Copper clad board 1 square feet	1	99	90	1	99	90
19.	Metal casing	1	500	00	1	500	00
20.	Wiring		500	00	1	500	00
		TOTAL COST			**=**	**15,797**	**30**

Memory Address	Label	OP Code	Operand	Hexcode		
F817		OUT	D8H	D3	D8	
F819		CALL	L-9	CD	3B	F8
F81C		MVI	A,80H	3E	80	
F81E		OUT	DBH	D3	DB	
F820		MVI	A,00H	3E	00	
F822		OUT	D8	D3	D8	
F824		JMP	L-1	C3	3A	F8
F827	L-2	MVI	A,80H	3E	80	
F829		OUT	DB	D3	DB	
F82B		MVI	A,FFH	3E	FF	
F82D		OUT	D9H	D3	D9	
F82F		CALL	L-10	CD	64	F8
F832		MVI	A,80H	3E	80	
F834		OUT	DBH	D3	DB	
F836		MVI	A,00H	3E	00	
F838		OUT	D9H	D3	D9H	
F83A	L-1	HLT		76		
F83B	L-9	MVI	A,90H	3E	90	
F83D		OUT	F3H	D3	F3	
F83F		MVI	01H	3E	01	

Memory Address	Label	OP Code	Operand	Hexcode		
F868		MVI	01H	3E	01	
F86A		IN	F0H	DB	F0	
F86C		CPI	FFH	FE	FF	
F86E		JZ	L-11	CA	80	F8
F871		CPI	00H	FE	00	
F873		JNZ	L-12	C2	89	F8
F876		INR	C	0C		
F877		DCR	D	15		
F878		LXI	H,F901	21	01	F9
F87B		MOV	A,M	7E		
F87C		CMP	C	B9		
F87D		JZ	L-13	CA	8C	F8
F880	L-11	LXI	B,135F	01	5F	13
F883	L-14	DCX	B	0B		
F884		MOV	A,B	78		
F885		ORA	B	B0		
F886		JNZ	L-14	C2	83	F8
F889	L-12	JMP	L-10	C3	64	F8
F88C	L-13	RET		C9		



FIG−4.1 POWER CIRCUIT

4.8 ADVANTAGES

1. This scheme of automation uses a 3 phase induction motor with a gear box instead of a stepper motor which is very costly. Gear box is used to reduce the speed of the induction motor, making the stoppage almost instantaneous. The 3 phase induction motor with a gear box gives reasonable accuracy at lower cost.

2. In this scheme we use MOSFETs and relays for phase sequence changing. If we use SCRs instead of MOSFETs and Relays, trouble-shooting is very difficult and also the cost of the scheme increases.

3. The use of microprocessor in the scheme provides the facility in positioning the back gauge at the desired place when the supply came after an interrupt during the positioning process.

4. Provides overload protection for motor.

5. Maintenance and trouble shoot is very simple.

6. Operating the scheme is easy.

4.9 TESTING

Testing was carried out on the scheme. INTEL 8085 microprocessor is used to produce control signal, by comparing the present position of the back gauge and the required position of the back gauge. The software written in assembly language for the above purpose is given in the table.

MICROPROCÊSSOR PROGRAM

Memory Address	Label	OP Code	Operand	Hexcode		
F800		LXI	H,F900H	21	00	F9
F803		XRA	A	AF		
F804		MVI	C,00H	0E	00	
F806		MOV	A,M	7E		
F807		SUB	D	92		
F808		STA	F901H	32	01	F9
F80B		JZ	L-1	CA	3A	F8
F80E		JC	L-2	DA	27	F8
F811		MVI	A, 80H	3E	80	
F813		OUT	DBH	D3	DB	
F815		MVI	A,FFH	3E	FF	

CHAPTER - V

CONCLUSION

A low cost scheme of automation for shearing machine with electro magnetic contactors, solid state switching devices and micro processor has been designed, developed and tested. The power circuitry has been fabricated using power MOSFETs. The control circuitry consisting of 8085 microprocessor and 8255A PPI is used to generate control signals. Testing of the scheme was carried out on an actual shearing machine and the result is satisfactory. This scheme offers the advantages of high accuracy, ease in operation and low cost. This scheme of automation increases the productivity with less effort at reduced production cost.

REFERENCES

1. Muhammad H. Rashid, “Power Electronics Circuits, Devices and Applications”, Prentice Hall of India Private Limited, New Delhi, 1996.

2. Sunil S. Rao, “Switch Gear and Protection”, Khanna Publishers, New Delhi, 1973.

3. Ramesh S. Gaonkar, “Microprocessor Architecture, Programming and Applications with the 8085/8080A”, Wiley Eastern Limited, New Delhi, 1994.

4. D. Roy Choudhury and Shail Jain, “Linear Integrated Circuits”, New Age International (P) Limited, Publishers, New Delhi, 1996.

5. F. Harsall and P.F. Lister, “Microprocessor Fundamentals”, Pitman Publishers, 1987.

6. Muhammed Rafiquzzaman, “Microprocessors and Microcomputer based System Design”, CRC Press, New Delhi, 1990.

APPENDIX A

SDA 85 MICROPROCESSOR KIT

SPECIFICATION

CPU	:	8085 operating at 3.072 MHz
MEMORY	:	EPROM : Two JEDEC compatible 28-pin sockets provide upto 16/32K bytes using 2x2764/27128 RAM : Two JEDEC compatible 28-pin sockets provide upto 2/16/32K bytes of CMOS static RAM using 6116/6264/62256; Provision to battery back the entire system RAM
INPUT/OUTPUT	:	PARALLEL 48 LINES, 8255*2 SERIAL THROUGH SID/SOD LINES. INTERFACES PROVIDED FOR TTX, CRT AND TELEPRINTER
INTERRUPTS	:	TRAP, RST 7.5, RST 6.5, RST 5.5 AND INTR. AN 8 BIT INTERRUPT INSTRUCTION PORT IS PROVIDED

TIMER	:	THREE 16-BIT COUNTER/TIMERS, USING 8253 PROGRAMMABLE TIMER
INTERFACES	:	ALL BUS AND PARALLEL INPUT/OUTPUT SIGNALS ARE TTL COMPATIBLE. OPTIONAL BUS DRIVERS FOR BUS EXPANSIONS AVAILABLE INPUT/ OUTPUT CONNECTION AND BUS CONNECTION TO FLEXIBLE FLAT CABLES
KEYBOARD/ DISPLAY	:	IMPLEMENT USING 8279 KEYBOARD DISPLAY FOUR FOR THE ADDRESS FIELD AND TWO FOR DATA FIELD

ADDRESSES

EPROM	0	TO	7FFFH
RAM	8000	TO	FFFFH
8279	D0 H	-	DATA
	D1 H	-	CONTROL
8255(1)	D8 H		PORT A
	D9 H		PORT B

	DA H	PORT C
	DB H	CONTROL 1
8255(2)	F0 H	PORT A
	F1 H	PORT B
	F2 H	PORT C
	F3 H	CONTROL 2
8253	C8 H	COUNTER 0
(TIMER)	C9 H	COUNTER 1
	CA H	COUNTER 2
	CB H	CONTROL
8212	10 H	INPUT PORT
	INTA	INTERRUPT
		INSTRUCTION PORT
		(RST INSTRUCTION)

MONITOR COMMAND : GO, SUBSTITUTE MEMORY, EXAMINE REGISTER, SINGLE STED, BLOCK MOVE, INSERT, DELETE, DISPLAY, PUNCH A PAPER TAPE, READ AN EPROM, PROGRAM AN EPROM

POWER SUPPLY, BASIC KIT, REQUIREMENT

5V + 5%, 1.5 A + 12 V + 10%, 100 MA OPTION

001 and 003 INTEGRAL SUPPLY SPECIFICATION

5V + 5%, 2.5 A

+12 V + 10%, 250 mA

20 V TO 26 V, 100 mA

ORDERING INFORMATION ALS-SDA 85-M :8085 TRAINER

APPENDIX B

PROGRAMMABLE PERIPHERAL INTERFACE

THE 8255A MAY ALSO TREATED AS FOUR MEMORY LOCATIONS AS SHOWN IN FIG. THE GROUP 1 CONSISTS OF PORT A AND PORT C UPPER AND GROUP 2 CONSISTS OF PORT C LOWER AND PORT B. THE SDA 85 KIT HAS TWO 8255A PPIS.

THE CONTROL WORD IS DETERMINED BY SELECTING THE MODE OF OPERATION AND GROUPS BEING INDIVIDUALLY SELECTED AS INPUT PORTS. THIS IS STORED IN THE CONTROL WORD REGISTER THUS INITIALISING THE PORT OPERATIONS. THE CONTROL WORD FORMAT IS SHOWN IN FIG. B-1.

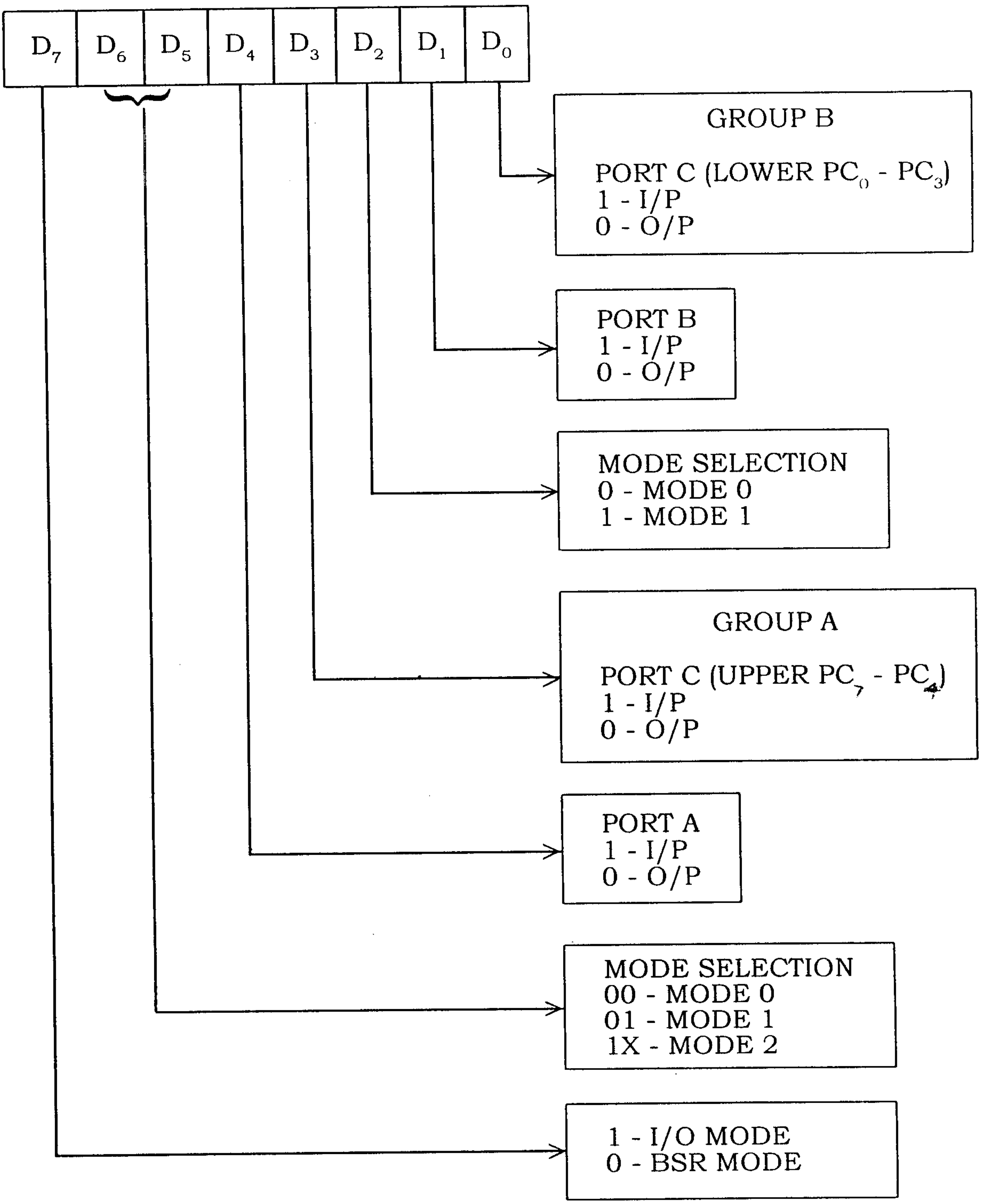
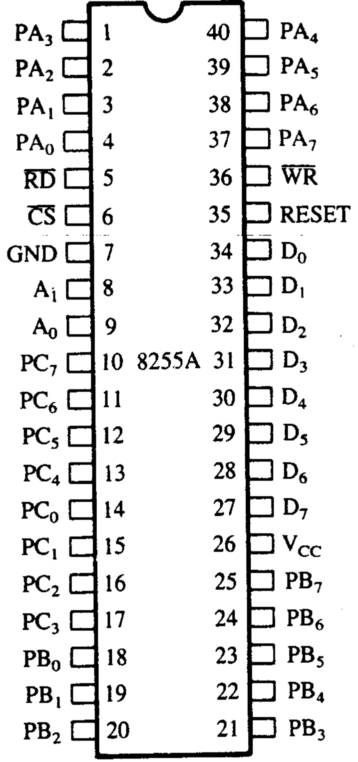
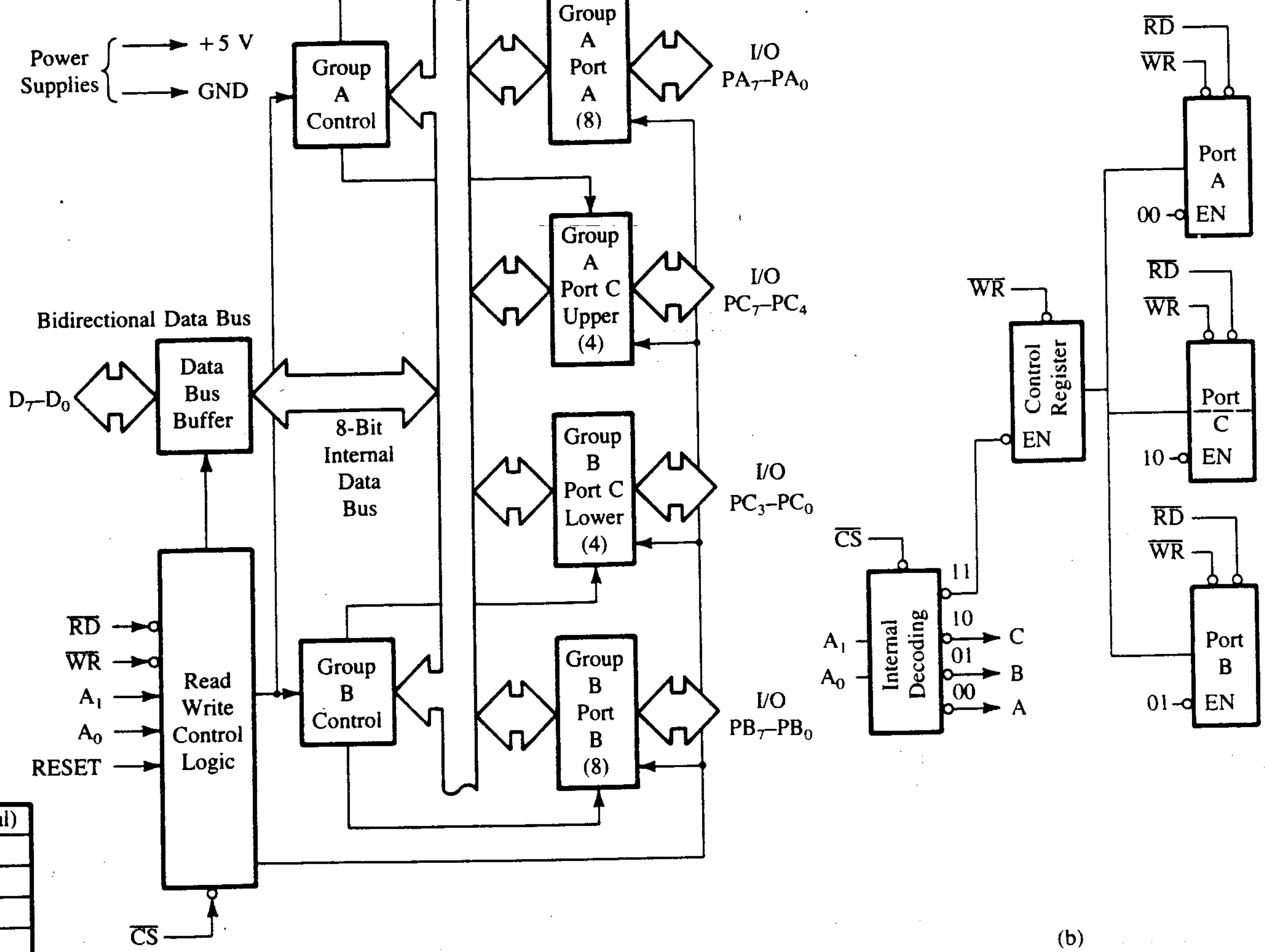


Fig. B1 8255A PPI CONTROL WORD FORMAT FOR I/O MODE



Pin Names

D_7–D_0	Data Bus (Bidirectional)
RESET	Reset Input
$\overline{CS}$	Chip Select
$\overline{RD}$	Read Input
$\overline{WR}$	Write Input
A_0, A_1	Port Address
PA_7–PA_0	Port A (Bit)
PB_7–PB_0	Port B (Bit)
PC_7–PC_0	Port C (Bit)
V_{CC}	+5 Volts
GND	0 Volts



(a)

(b)

FIGURE

8255A Block Diagram (a) and an Expanded Version of the Control Logic and I/O Ports (b)

SOURCE: A: Intel Corporation, *MCS—80/85 Family User's Manual* (Santa Clara, Calif.: Author, 1979), p. 6-162.