AUTOMATION AND TESTING OF AEROFEED CONTROL PANEL

A PROJECT REPORT

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COIMBATORE – 641 006

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BONAFIDE CERTIFICATE

Certified that this project report entitled **"AUTOMATION AND TESTING OF AEROFEED CONTROL PANEL"** is the bonafide work of

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Mr.P.Thirumoorthi

Certified that the candidate with university Register No. 71204105033, 71204105043, 71204105053 was examined in project viva voce Examination held on 21/4/2008

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LAKSHMI ELECTRICAL CONTROL SYSTEMS LIMITED

PROJECT COMPLETION CERTIFICATE

Date : 14.04.2008

This is to certify that the following students of final B.E., Electrical and Electronics Engineering of KUMARAGURU COLLEGE OF TECHNOLOGY, COIMBATORE-06 has successfully completed the industrial project in our control panel division from December 10th -2007 to March 31st- 2008 on the topic "AUTOMATION AND TESTING OF AEROFEED CONTROL PANEL".

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Their conduct and behaviour was found to be GOOD during this period.

[G.RAVICHANDRAN]
Sr.Manager CPD.

ABSTRACT

This project is to make the testing procedure simple by automating it with the help of PLC (Programmable Logic Controller) (S7-200).Automation is playing a vital role in almost all fields of engineering. Our project envisages automating the testing of control panels namely carding panel and Aerofeed panel which are used in controlling the electrical parameters of motors used in textile industry. By automation of the testing process, the industry is benefited in saving a lot of time and reduced manual work.

This project provides the provision of using PLC for automation. In the testing of carding panel, the delay program using timers in the test jig PLC(S7-200) is used to give signal to the PLC and other components (relays, contactors etc) in the panel which then operates to give signal to the LED's in the jig. In the testing of aerofeed panel, the signal from the test jig PLC (S7-200) goes to the panel relays, contactors, inverters etc to operate them and the signal from them in turn make the LED's on the test jig to glow.

ACKNOWLEDGEMENT

It is our bounden duty to thank the contribution made in one form or the other by the individuals we hereby acknowledge. We are highly privileged to thank Dr.Joseph V Thanikal, Principal, Kumaraguru College of Technology for allowing us to do this project. We express our heart felt gratitude and thanks to the HOD of Electrical and Electronics Engineering, Prof. K. Regupathy Subramanian, for encouraging us and for being with us right from beginning of the project and guiding us at every step.

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CHAPTER 1

INTRODUCTION

1 . INTRODUCTION

1.1 OBJECTIVE

Our objective is to automate the testing of control panels(aerofeed and carding using PLC programming, in co-operation with the company personnel. This project wi help the industry to increase its turnover due to reduced time panel production an reduced time for testing.

Coimbatore is an industrial city, well known for textile and small engineerin units. The textile units are mostly employed in manufacturing of machines at variou levels from the preparation of cotton bales to the fine thread which is the final stag Control panels are needed to control the operations of these machines at various stage These control panels are manufactured by LECS and other group of companies. Since thi testing is done manually we thought of automating this task through PLC programmin Hence we selected this project.

1.2 CONTROL PANEL SEQUENCE IN TEXTILE MACHINERY

In the spinning system, the following are the panels used to control the motors at various stages wherein cotton is converted into fine thread.

1. Blowroom
2. Carding.
3. Drawframe.
4. Speedframe.
5. Ringframe.

BLOWROOM

This is the initial stage in the process of spinning. The raw material (i.e) unpure cotton which is fed will have various impurities like sticks,dust particles etc in them in large quantities. Thus this section takes care in cleaning the cotton and ready for the next section.

This inturn has various stages. They are

1. Mixing bale opener.
2. Unimix.
3. Vario cleaner.
4. Flexi cleaner
5. Bale plucker.

CARDING

The pure cotton in the form of bales from the blowroom section before being fed into the carding section is converted into cotton sheets of uniform thickness by the aerofeen machine. Here the cotton sheets are converted into threads of bigger size.

This is achieved by employing the following motors.

1. Main motor.
2. Brush motor
3. Can change motor
4. Plug for grinding.
5. Philipson motor.

It also controls various other functions like

1. Cylinder belt safety.
2. Cylinder rotation.
3. Flats movement.
4. Stripper movement.
5. Pressure switch.
6. Doffing roller / Grooved roller safety.
7. Suction flap.
8. Can forward.
9. Can reverse etc.,

DRAWFRAME

Here threads of size which is smaller than that of the carding machine output is obtained.

SPEEDFRAME

Here the thread obtained is stronger by undergoing several processes. Also the thread obtained is very fine.

RINGFRAME

This is the final stage of the spinning process.
Here the thread count is decided.
The count may be from 20,20,40………
If the count is less then the thread is said to be weak.
If the count is high the the thread is said to be strong.

As the count increases the strength of the thread also increases.

Thus the above are the various stsges involved in the spinning system.

1.3 NEED FOR AUTOMATION

Due to manual testing of these control panels a lot of time and human resourc are getting wasted. Many discontinuities and faults may go un-noticed. It becomes ve difficult to find the point of fault, since lot of connections are available.

To eliminate these problems we proposed to automate the testing of control pane using PLC programming.

1.4 ORGANISATION OF THE PROJECT

PLC PROGRAMMING

The PLC software (S7-200) is used for programming with the help of sequence, written based on the testing procedure. This is explained in detail in chapter 4 and chapter 5.

DESIGN OF AEROFEED PANEL TEST JIG

The PLC and other components used in this test zig is programmed and the signals from them control the panel operations. The details are explained in chapter 4.

DESIGN OF CARDING PANEL TEST JIG

The PLC connections are arranged as to give the delay signals at correct time which enables the operation of panel PLC and other components like relays etc. the detailed explanation is given in chapter 5.

CHAPTER 2
PROGRAMMABLE LOGIC CONTROLLER(PLC)

2. PROGRAMMABLE LOGIC CONTROLLER(PLC)

2.1 INTRODUCTION

Programmable Logic Controllers (PLCs), also referred to as programmable controllers, are in the computer family. They are used in commercial and industrial applications. A PLC monitors inputs, makes decisions based on its program, and controls outputs to automate a process or machine. This course is meant to supply you with basic information on the functions and configurations of PLCs.

2.2 TERMINOLOGY

The language of PLCs consists of a commonly used set of terms; many of which are unique to PLCs. In order to understand the ideas and concepts of PLCs, an understanding of these terms is necessary.

SENSOR

A sensor is a device that converts a physical condition into an electrical signal for use by the PLC. Sensors are connected to the input of a PLC. A pushbutton is one example of a sensor that is connected to the PLC input. An electrical signal is sent from the pushbutton to the PLC indicating the condition (open/closed) of the pushbutton contacts.

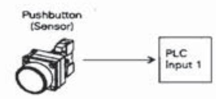


Fig 2.1 Sensor

ACTUATORS

Actuators convert an electrical signal from the PLC into a physical conditio
Actuators are connected to the PLC output. A motor starter is one example of an actuat
that is connected to the PLC output. Depending on the output PLC signal the motor start
will either start or stop the motor.

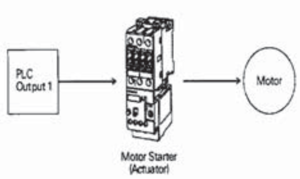


Fig 2.2 Actuator

DISCRETE INPUT

A discrete input, also referred to as a digital input, is an input that is either in
ON or OFF condition. Pushbuttons, toggle switches, limit switches, proximity switche
and contact closures are examples of discrete sensors which are connected to the PL
discrete or digital inputs. In the ON condition a discrete input may be referred to as
logic 1 or a logic high. In the OFF condition a discrete input may be referred to as a log
0 or a logic low. A Normally Open (NO) pushbutton is used in the following exampl
One side of the pushbutton is connected to the first PLC input. The other side of t
pushbutton is connected to an internal 24 VDC power supply. Many PLCs require
separate power supply to power the inputs. In the open state, no voltage is present at t
PLC input. This is the OFF condition. When the pushbutton is depressed, 24 VDC
applied to the PLC input. This is the ON condition.

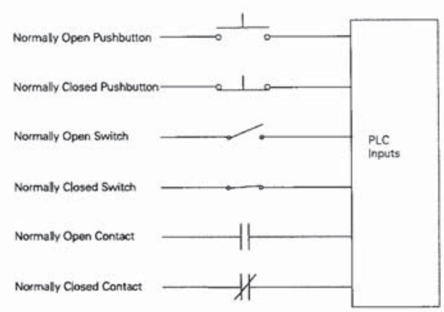


Fig 2.3 Different inputs to PLC

ANALOG INPUTS

An analog input is a continuous, variable signal. Typical analog inputs may vary from 0 to 20 milliamps, 4 to 20 milliamps, or 0 to 10 volts.

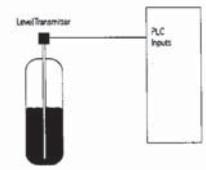


Fig 2.4 Example for an analog input

DISCRETE OUTPUTS

A discrete output is an output that is either in an ON or OFF condition. Solenoids, contactor coils, and lamps are examples of actuator devices connected to discrete outputs. Discrete outputs may also be referred to as digital outputs.

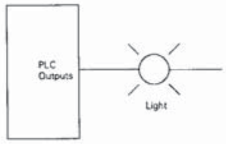


Fig 2.5 Example for an discrete output

ANALOG OUTPUTS

An analog output is a continuous, variable signal. The output may be as simple as 0-10 VDC level that drives an analog meter. Examples of analog meter outputs are spee weight, and temperature.

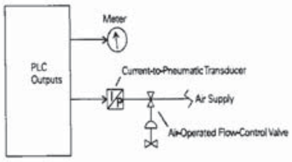


Fig 2.6 Example for an analog output

CPU

The central processor unit (CPU) is a microprocessor system that contains tl system memory and is the PLC decision-making unit. The CPU monitors the inputs ai makes decisions based on instructions held in the program memory. The CPU perforr relay, counting, timing, data comparison, and sequential operations.

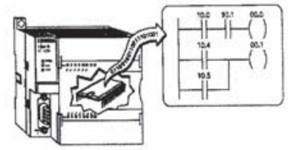


Fig 2.7 CPU module of PLC

BASIC REQUIREMENTS

In order to create or change a program, the following items are needed:

- PLC
- Programming Device
- Programming Software
- Connector Cable

PLC

Throughout this course we will be using the S7-200 because of its ease of use.

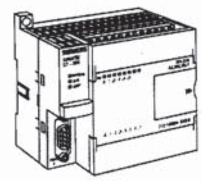


Fig 2.8 PLC module

2.3 PROGRAMMING DEVICES

The program is created in a programming device (PG) and then transferred to the PLC. The program for the S7-200 can be created using a dedicated Siemens SIMATIC S7 programming device, such as a PG 740, if STEP 7 Micro/WIN software is installed.

PROGRAMMING IN PLC

A program consists of one or more instructions that accomplish a tasl Programming a PLC is simply constructing a set of instructions. There are several ways to look at a program such as ladder logic, statemer lists, or function block diagrams.

LADDER LOGIC

Ladder logic (LAD) is one programming language used with PLCs. Ladder logi uses components that resemble elements used in a line diagram format to describe harc wired control.

LADDER LOGIC DIAGRAM

The left vertical line of a ladder logic diagram represents the power or energize conductor. The output element or instruction represents the neutral or return path of th circuit. The right vertical line, which represents the return path on a hard-wired contrc line diagram, is omitted. Ladder logic diagrams are read from left-to-right, top-to-bottom Rungs are sometimes referred to as networks. A network may have several contrc elements,but only one output coil.

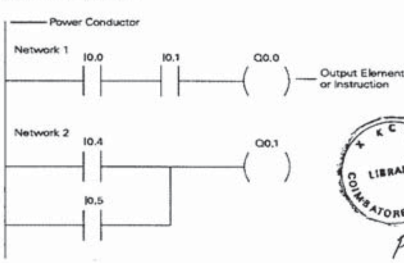


Fig 2.9 Simple ladder logic

In the example program shown example I0.0, I0.1 and Q0.0 represent the fir instruction combination. If inputs I0.0 and I0.1 are energized, output relay Q0. energizes. The inputs could be switches, pushbuttons, or contact closures. I0.4, I0.5, an

Q1.1 represent the second instruction combination. If either input I0.4 or I0.5 are energized, output relay Q0.1 energizes.

STATEMENT LIST

A statement list (STL) provides another view of a set of instructions. The operation, what is to be done, is shown on the left. The operand, the item to be operated on by the operation, is shown on the right. A comparison between the statement list shown below, and the ladder logic shown on the previous page, reveals a similar structure.

Network 1

```
LD  I0.0
A   I0.1
=   Q0.0
```

FUNCTION BLOCK DIAGRAMS

Function Block Diagrams (FBD) provide another view of a set of instructions. Each function has a name to designate its specific task. Functions are indicated by a rectangle. Inputs are shown on the left-hand side of the rectangle and outputs are shown on the right-hand side.

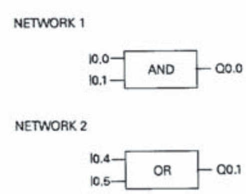


Fig 2.10 Diagram showing simple networks

2.4 S7-200 PLCs

The S7-200 Micro PLC is the smallest member of the SIMATIC S7 family c programmable controllers. The programming port is the connection to the programmin device.S7-200 Models There are five S7-200 CPU types: CPU 221, CPU 222, CPU 22 CPU 224XP, and CPU 226 and two power supply configurations for each type.

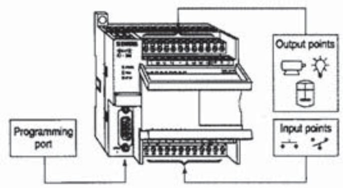


Fig 2.11 PLC showing connection points

EXPANSION MODULES

The S7-200 PLCs are expandable. Expansion modules contain additional inputs ar outputs. These are connected to the base unit using a ribbon connector.The ribbc connector is protected by a cover on the base unit. Side-by-side mounting complete encloses and protects the ribbon connector.

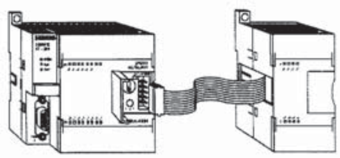


Fig 2.12 Interconnection of expansion modules in PLC

2.5 TIMERS

Timers are devices that count increments of time.Timers are represented by boxes in ladder logic. When a timer receives an enable, the timer starts to time. The timer compares its current time with the preset time. The output of the timer is a logic 0 as long as the current time is less than the preset time. When the current time is greater than the preset time the timer output is a logic 1.

S7-200 uses three types of timers:

On-Delay (TON), Retentive On-Delay (TONR), and Off-Delay (TOF).

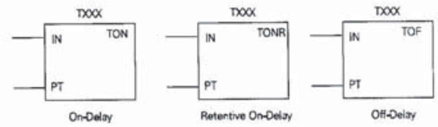


Fig 2.13 Representation of various timers

ON-DELAY TIMER

When the On-Delay timer (TON) receives an enable (logic 1) at its input (IN), a predetermined amount of time (preset time - PT) passes before the timer bit (T-bit) turns on. The T-bit is a logic function internal to the timer and is not shown on the symbol.The timer resets to the starting time when the enabling input goes to a logic 0.

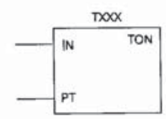


Fig 2.14 Representation of on delay timer

RETENTIVE ON-DELAY TIMER (TONR)

The Retentive On-Delay timer (TONR) functions in a similar manner to the On Delay timer (TON). There is one difference.The Retentive On-Delay timer times as lon as the enabling input is on, but does not reset when the input goes off. The timer must b reset with a RESET (R) instruction.

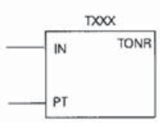


Fig 2.15 Representation of retentive on-delay timer

OFF-DELAY TIMER

The Off-Delay timer is used to delay an output off for a fixed period of time aft the input turns off. When the enabling bit turns on the timer bit turns on immediately an the value is set to 0. When the input turns off, the timer counts until the preset time ha elapsed before the timer bit turns off.

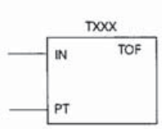


Fig 2.16 Representation of off-delay timer

COUNTERS

Counters used in PLCs serve the same function as mechanical counters. Counte compare an accumulated value to a preset value to control circuit functions. Contr applications that commonly use counters include the following:

- Count to a preset value and cause an event to occur
- Cause an event to occur until the count reaches a preset value

A bottling machine, for example, may use a counter to count bottles into groups of six for packaging.

Counters are represented by boxes in ladder logic. Counters increment/decrement one count each time the input transitions from off (logic 0) to on (logic 1). The counters are reset when a RESET instruction is executed. S7-200 uses three types of counters:

up counter (CTU), down counter (CTD), and up/down counter (CTUD).

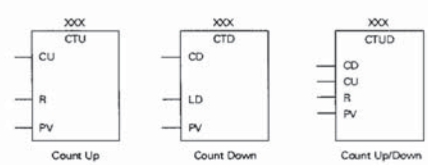


Fig 2.17 Representation of various counters

S7-200 COUNTERS

There are 256 counters in the S7-200, numbered C0 through C255. The same number cannot be assigned to more than one counter. For example, if an up counter is assigned number 45, a down counter cannot also be assigned number 45. The maximum count value of a counter is ±32,767.

UP COUNTER

The up counter counts up from a current value to a preset value (PV). Input CU is the count input. Each time CU transitions from a logic 0 to a logic 1 the counter increments by a count of 1.Input R is the reset. A preset count value is stored in PV input. If the current count is equal to or greater than the preset value stored in PV, the output bit (Q) turns on (not shown).

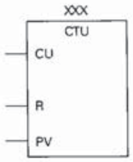


Fig 2.18 Representation of UP counter

DOWN COUNTER

The down counter counts down from the preset value (PV) each time C transitions from a logic 0 to a logic 1. When the current value is equal to zero the count output bit (Q) turns on (not shown). The counter resets and loads the current value wi the preset value (PV) when the load input (LD) is enabled.

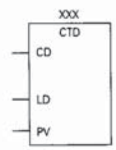


Fig 2.19 Representation of down counter

UP/DOWN COUNTER

The up/down counter counts up or down from the preset value each time either C or CU transitions from a logic 0 to a logic 1. When the current value is equal to the pres value, the output QU turns on. When the current value (CV) is equal to zero, the outp QD turns on. The counter loads the current value (CV)with the preset value (PV) wh the load input (LD) is enabled.Similarly, the counter resets and loads the current val (CV) with zero when the reset (R) is enabled. The counter stops counting when it reach preset or zero.

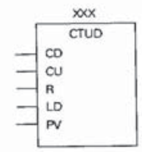


Fig 2.19 Representation of UP/DOWN counter

2.6 ADVANTAGES OF PLCS

The same, as well as more complex tasks, can be done with a PLC. Wiring between devices and relay contacts is done in the PLC program. Hard-wiring, though still required to connect field devices, is less intensive. Modifying the application and correcting errors are easier to handle. It is easier to create and change a program in a PLC than it is to wire and re-wire a circuit.

Following are just a few of the advantages of PLCs:

- Smaller physical size than hard-wire solutions.
- Easier and faster to make changes.
- PLCs have integrated diagnostics and override functions.
- Diagnostics are centrally available.
- Applications can be immediately documented.
- Applications can be duplicated faster and less expensively.

CHAPTER 3

COMPONENTS OF AEROFEED AND CARDING PANEL

3.COMPONENTS OF AEROFEED AND CARDING PANEL

3.1 RELAY

A relay is an electrically operated switch. Current flowing through the coil of the relay creates a magnetic field which attracts a lever and changes the switch contacts. The coil current can be on or off so relays have two switch positions and they are double throw (changeover) switches.

Fig 3.1 Relay

Relays allow one circuit to switch a second circuit which can be completely separate from the first. For example a low voltage battery circuit can use a relay to switch a 230V AC mains circuit. There is no electrical connection inside the relay between the two circuits, the link is magnetic and mechanical. The coil of a relay passes a relatively large current, typically 30mA for a 12V relay, but it can be as much as 100mA for relays designed to operate from lower voltages. The maximum output current for the popular 555 timer IC is 200mA so these devices can supply relay coils directly without amplification. The relay's switch connections are usually labelled COM, NC and NO:

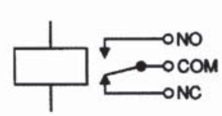


Fig 3.2 Basic relay contacts

COM = Common, always connect to this, it is the moving part of the switch.

NC = Normally Closed, COM is connected to this when the relay coil is off.

NO =Normally Open, COM is connected to this when the relay coil is on.

Connect to COM and NO if you want the switched circuit to be on when the relay co
is on.

Connect to COM and NC if you want the switched circuit to be on when the relay co
is off.

ADVANTAGES OF RELAYS

- Relays can switch AC and DC, transistors can only switch DC.
- Relays can switch high voltages, transistors cannot.
- Relays are a better choice for switching large currents (> 5A).
- Relays can switch many contacts at once.

DISADVANTAGES OF RELAYS

- Relays are bulkier than transistors for switching small currents.
- Relays cannot switch rapidly (except reed relays), transistors can switch man times per second.
- Relays use more power due to the current flowing through their coil.
- Relays require more current than many ICs can provide, so a low power transistc may be needed to switch the current for the relay's coil.

3.2 CONTACTORS

When a relay is used to switch a large amount of electrical power through it contacts, it is designated by a special name: *contactor*. Contactors typically have multipl

the load is shut off when the coil is de-energized. Perhaps the most common industrial us for contactors is the control of electric motors.

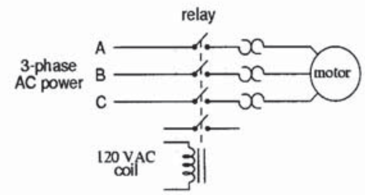


Fig 3.3 Contactor used in real time

Shown here is a contactor for a three-phase electric motor, installed on a panel as part of an electrical control system at a municipal water treatment plant:

Fig 3.4 Diagram showing contactor

Three-phase, 480 volt AC power comes in to the three normally-open contacts at the top of the contactor via screw terminals labeled "L1," "L2," and "L3" (The "L2" terminal is hidden behind a square-shaped "snubber" circuit connected across the contactor's coil

hidden behind a square-shaped "snubber" circuit connected across the contactor's coil
terminals). Power to the motor exits the overload heater assembly at the bottom of this device via screw terminals labeled "T1," "T2," and "T3."

REVIEW

- A *contactor* is a large relay, usually used to switch current to an electric motor or other high-power load.
- Large electric motors can be protected from overcurrent damage through the use of *overload heaters* and *overload contacts*. If the series-connected heaters get too hot from excessive current, the normally-closed overload contact will open, de-energizing the contactor sending power to the motor.

3.3 SENSORS

OMRON Sensing Components detect, measure, analyze, and process various change that occur on productions sites, such as changes in position, length, height, displacemen and appearance. They also contribute to predicting and preventing future events.

PROXIMITY SENSORS

Proximity Sensors are available in models using high-frequency oscillation to dete ferrous and non-ferrous metal objects and in capacitive models to detect non-met objects. Models are available with environment resistance, heat resistance, resistance t chemicals, and resistance to water.

3.4 CIRCUIT BREAKER

A circuit breaker is an automatically-operated electrical switch designed to protect a electrical circuit from damage caused by overload or short circuit. Unlike a fuse, whic operates once and then has to be replaced, a circuit breaker can be reset (either manuall or automatically) to resume normal operation. Circuit breakers are made in varying size from small devices that protect an individual household appliance up to large switchge designed to protect high voltage circuits feeding an entire city.

OPERATION

All circuit breakers have common features in their operation, although details va substantially depending on the voltage class, current rating and type of the circuit breake The circuit breaker must detect a fault condition; in low-voltage circuit breakers this usually done within the breaker enclosure. Large high-voltage circuit breakers ha separate devices to sense an overcurrent or other faults. Once a fault is detected, contac within the circuit breaker must open to interrupt the circuit; some mechanically stor energy within the breaker is used to separate the contacts, although some of the ener required may be obtained from the fault current itself. When a current is interrupted, arc is generated - this arc must be contained, cooled, and extinguished in a controll way, so that the gap between the contacts can again withstand the voltage in the circu

Finally, once the fault condition has been cleared, the contacts must again be reclosed to restore power to the interrupted circuit.

3.5 VARISTOR

A varistor is a type of resistor with a significantly non-ohmic current-voltage characteristic. The name is a portmanteau of variable resistor*, which is misleading since it is not continuously user-variable like a potentiometer or rheostat, and is not a resistor but in fact a capacitor. Varistors are often used to protect circuits against excessive voltage by acting as a spark gap.

The most common type of varistor is the metal oxide varistor, or MOV. This contains a mass of zinc oxide grains, in a matrix of other metal oxides, sandwiched between two metal plates (the electrodes). The boundary between each grain and its neighbour forms a diode junction, which allows current to flow in only one direction. The mass of randomly oriented grains is electrically equivalent to a network of back-to-back diode pairs, each pair in parallel with many other pairs. When a small or moderate voltage is applied across the electrodes, only a tiny current flows, causes by reverse leakage through the diode junctions. When a large voltage is applied, the diode junctions break down because of the avalanche effect, and a large current flows. The result of this behaviour is a highly nonlinear current-voltage characteristic, in which the MOV has a high resistance at low voltages and a low resistance at high voltages. If the size of the transient pulse (often measured in joules) is too high, the device may melt, or otherwise be damaged. For example, a nearby lightning strike may permanently damage a varistor.

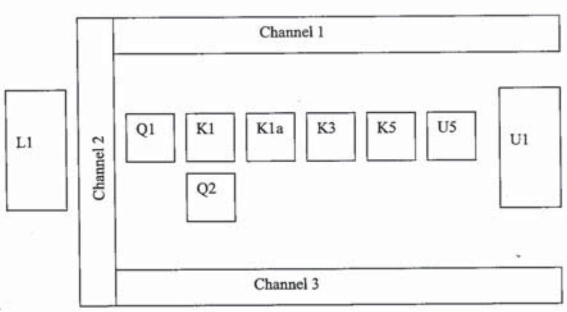
Important parameters for varistors are response time (how long it takes the varistor to break down), maximum current and a well-defined breakdown voltage. When used in communications lines (such as phone lines used for modems), high capacitance is undesirable since it absorbs high frequency signals, thereby reducing the available bandwidth of the line being protected.

CHAPTER 4

AEROFEED PANEL AND ITS TESTING

4.AEROFEED PANEL AND ITS TESTING

4.1 OVERVIEW OF AEROFEED PANEL



4.1 Aerofeed Panel block diagram

L1 - Choke .
Q1 - Motor protection circuit breaker.
K1A - Relay.
K1 - Contactor.
K3 - Relay.
K5 - Relay.
U5 - Varistor board.
Q2 - Overload relay.
U1 - Inverter.

4.1.2 CIRCUIT DIAGRAM

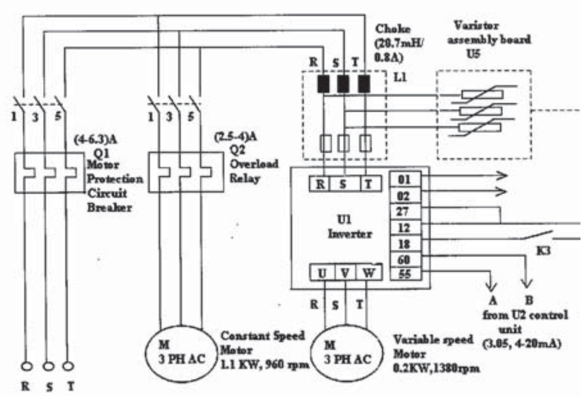


Fig 4.2 Aerofeed Panel Circuit Diagram

4.1.3 DESCRIPTION

A three phase supply is given to the MPCB(Motor Protection Circuit Breaker).When it is switched ON the supply goes to the contactor K1 and choke L1. K1 is connected to the overload protection relay Q2 which protects the opening roller motor M1 under overload conditions. The varistor board U5 connected across L1 is used to reduce the harmonics by earthing the spikes in the supply. The choke L1 is used to reduce the oscillations thereby protecting the inverter connected to it.
Based on the output of the sensor the inverter produces a variable frequency output which controls the speed of the variable speed motor M2.

4.2 OVERVIEW OF CONTROL CIRCUIT

4.2.1 DESCRIPTION

A 220V AC supply is given to switch S4 which when ON supplies Q1&Q2.The inverter connected to Q2 is ON when it receives its 220V but does not read the frequency until K3 relay operates. On closure of S1,S2 &S3 on the machine side the relay K5 operates and supplies the two conveyors on the machine side. The value of switch S5 if 0 then conveyor1 operates and gives the output and if S5=1 conveyor2 operates and gives the output. This output operates the relays K1, K1a & K3.When K3 operates the electrovalve Y1 gets ON. The fan runs as soon as the 220V supply is given.

4.2.2 CIRCUIT DIAGRAM

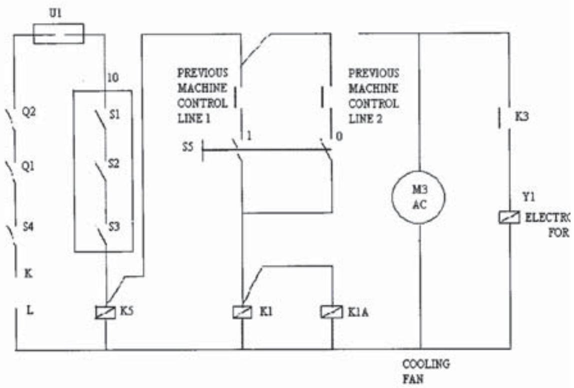
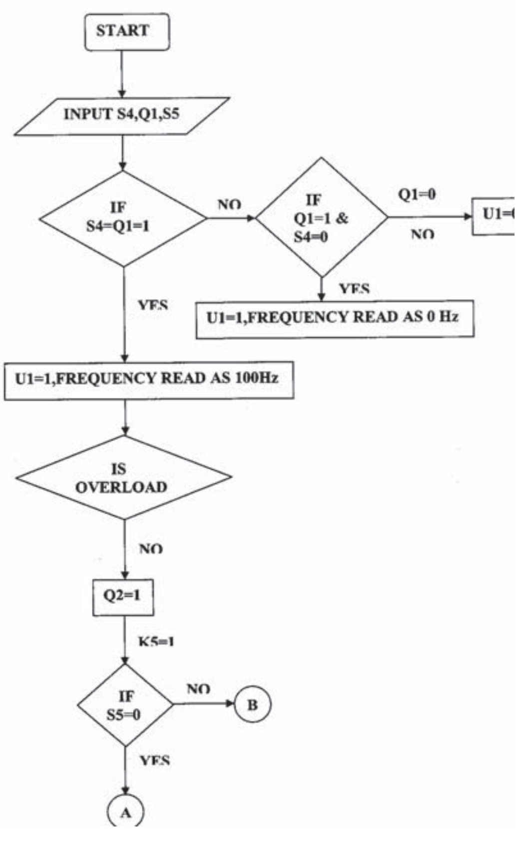


Fig 4.3 Aerofeed Control Circuit Diagram

Q1 - Motor Protection Circuit Breaker
Q2 - Overload relay
K1 - Contactor
K5, K1A, K3 - Relays
S4, S5 - Switches
M3 - Cooling Fan
Y1 - Electro valve for flap

4.2.3 FLOWCHART



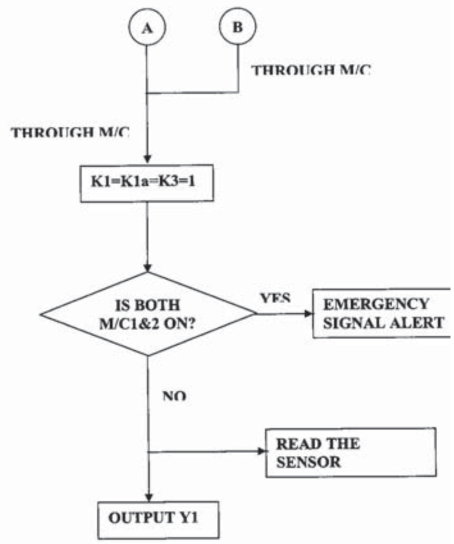


Fig 4.4 Flowchart for the testing conditions

4.3 IMPACT OF PANEL ON MACHINE CONTROL

We have five switches on the machine side(S1,S2,S3,S4&S5).The inputs of S1,S2&S3 are given through PLC by a delay.We also have two motors. They are constant speed motor M1 and variable speed motor M2. The motor M1 supplies the cotton sheets at a constant speed to the conveyors. The thickness of cotton in the conveyors is sensed by two sensors namely an upper and a lower sensor(Current sensors).

If the thickness of cotton is uniform then the output of the sensor will be constant i.e.4.2mA.

If the thickness of cotton has increased the output current of the sensor decreases thereby a decreased frequency output is obtained which inturn decreases the speed of the motor M2.

If the thickness of cotton has decreased the output current of the sensor increases thereby an increased frequency output is obtained which inturn increases the speed of the motor M2.

This process continues in order to obtain cotton of uniform thickness.

4.4 OVERVIEW OF TEST JIG

4.4.1 DESCRIPTION

The test jig is designed for testing the aerofeed panel. It is basically consists of power supply unit, transformer, sensor, PLC (S7200) and miniature circuit breaker. The panel gets its supply from the test jig.

Power supply given to MCB is stepped up to 400V and 220V AC. 400V AC is given to the panel as supply and 220V AC is given to power supply which converts it into 24V DC. This 24V DC is given to the sensor and the PLC. The inputs to the PLC is give through the toggle switch. According to the PLC programming the outputs are produced. These outputs are connected to the terminal stack which inturn is connected to the panel.

4.4.2 BLOCK DIAGRAM WITH PLC CONNECTION

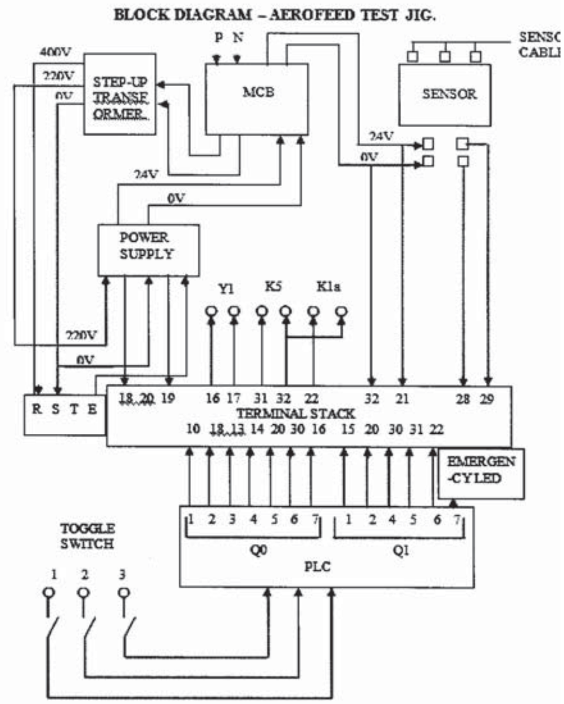


Fig: 4.4 Block diagram with plc connection

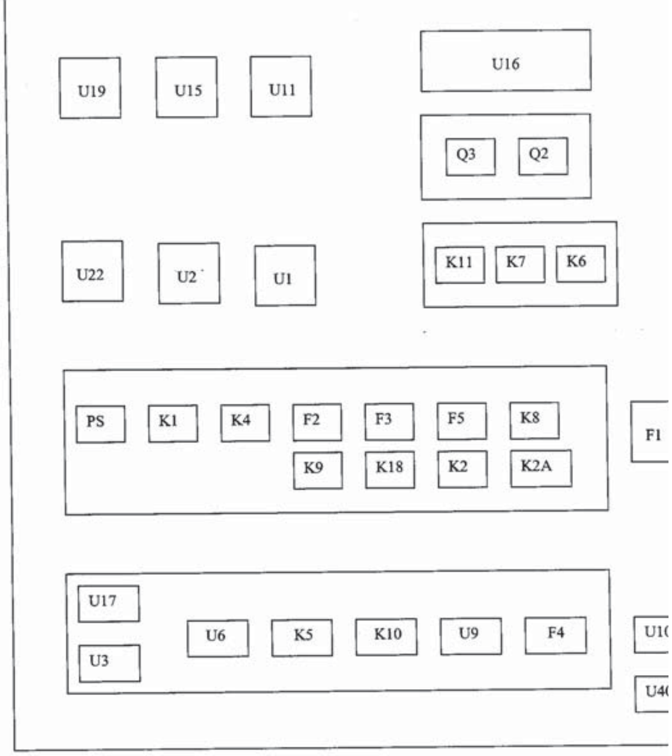
4.4.3 TESTING PROCEDURE

1. Input toggle switch I0.0 is toggled once to start the testing sequence.
2. Supply is given to the inverter through terminal 10.
3. After 5 sec through terminal 18 the inverter delivers the output when switch S4 is closed.
4. After 20 sec the input motor is switched ON through terminal 13, which then turns ON the lower level sensor, which is indicated by the lamp k5.
5. After 10 sec the upper level sensors are switched ON through terminal 21, which is indicated by the lamp k1a.
6. Supply is given to position 1 of switch S5 when I0.1 is switched ON; similarly supply is given to position 2 of switch S5 when I0.2 is switched ON.
7. Relay k1a is closed when supply is given to terminal 20.
8. Relay K5 is closed when supply is given to terminal 30, which then turns ON the cooling fan.
9. Through terminal 16 the electric flap is switched ON which is indicated by the lamp Y1.
10. The warning lamp will flicker if both Line1 and Line2 are switched ON.

CHAPTER 5
CARDING PANEL AND ITS TESTING

5. CARDING PANEL AND ITS TESTING

5.1.1 CARDING PANEL – BLOCK DIAGRAM



U19, U15, U11	-	Choke
U22, U2, U1	-	Inverter
U16	-	Varistor
Q3, Q2	-	Motor Protection Circuit Breaker
K11, K7, K6		
K9, K18, K2	-	Contactor
K2A		
U17	-	Resistor Assembly
U3	-	Rectifier Assembly
U6	-	PLC
K5, K10, K1	-	Control Relay
U9	-	Proximity Sensor
F4	-	Thermistor Protection Unit
F1,F2, F3, F5	-	Miniature Circuit Breaker
U10	-	Capacitor
U40	-	Rectifier

DESCRIPTION

The carding panel is the one which controls all the electrical parameters of th machines used in carding process. It has various components such as motor protectio circuit breakers, relays, contactors, PLC, sensors, thermistor protection unit, inverters choke, varistor assembly etc., The transformer is used to step down the voltage to suppl the various components of the panel. The power supply is used to convert the 220V A(into 24V DC which is used by the sensors and PLC's.

There are three inverters employed which are used to adjust the speed of doffe motor , feed motor and delivery motor respectively. The speed adjustment is done base on the sensor output (i.e) the difference in the reference current value and the sense value is used to change the frequency which inturn adjusts the motor speed. Each inverte is protected by the choke which is placed before the inverter and a varistor boar assembly inorder to reduce the harmonics by grounding the spikes occurring in th

supply. All the remaining motors in the machine side are connected to the supply through the contactors.

5.1.2 PLC CIRCUIT DIAGRAM – DESCRIPTION

U6 POWER SUPPLY	CPU	ANALOG INPUT MODULE 1	ANALOG INPUT MODULE 2	DIGITAL INPUT MODULE 3	DIGITAL INPUT MODULE 4	DIGITAL OUTPUT MODULE 5	RELAY OUTPU' MODUL

The PLC used here is AB(Alen Bradley). The program is fed and is stored in the CPU. U6 is the power supply unit to the panel PLC. It also supplies power to the panel display.

The analog input module is the first module in the panel PLC. The nature of its input is in the analog form. It has four channels. Channel 0 is connected to the amplifier, channel 1 to the sensor unit which senses the feed thickness, channel 2 to the double lap sensor LHS and channel 3 to the double lap sensor RHS respectively.

The analog output is the second module. It has four channels. Channels 0,1,2&3 gives the reference signals to the doffer motor, feed motor, chute feed motor & delivery motor respectively.

The digital input module 3&4 has 15 input terminals. The input comes from various sources. As soon as the signal reaches the input terminal the particular LED glows. The digital output module 5 has eight terminals and its output LED glows as a result of a particular operation.

The output signal from the relay output module 6 makes the electrovalves to operate and their working is indicated by the LED's glowing in the test jig.

5.2 OVERALL VIEW OF TEST JIG

For the testing of carding panel we use test jig. It consist of lamp indications an PLC's along with terminal stack. The PLC's here gives signals to the panel componen and the lamp indications are used to ensure that supply is coming to the particular motor The PLC used here is siemens S7 200 type. We have used two PLC's with four expansio modules. The outputs from these PLC's are given to various components of the pan through the terminal stacks. By this way the signal passes to and fro the panel.

5.2.1 BLOCK DIAGRAM OF PLC INDICATIONS

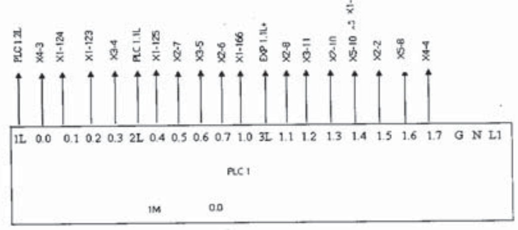


Fig 5.10 Block Diagram of PLC1 Connections

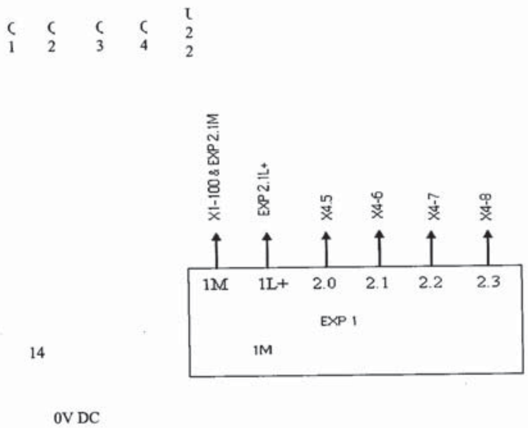


Fig 5.11 Block diagram of PLC 1-expansion 1 connections

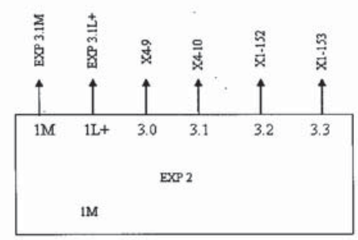


Fig 5.12 Block diagram of PLC 1- expansion 2 connections

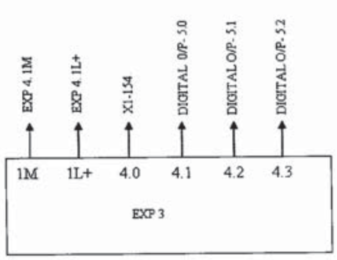


Fig 5.13 Block diagram of PLC 1- expansion 3 connections

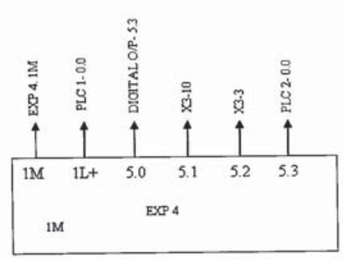


Fig 5.14 Block diagram of PLC 1- expansion 4 connections

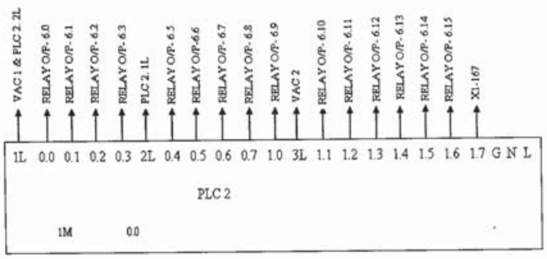
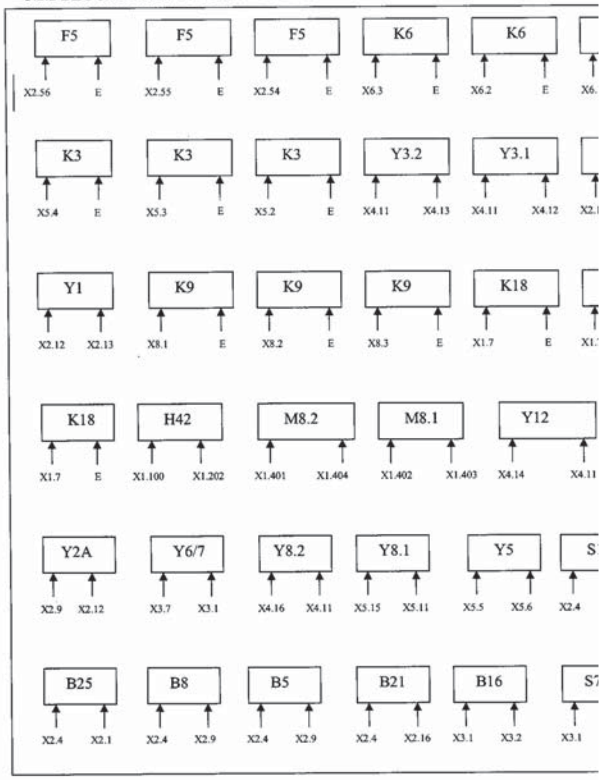


Fig 5.15 Block diagram of PLC 2 connections

5.2.2 BLOCK DIAGRAM OF LED INDICATIONS



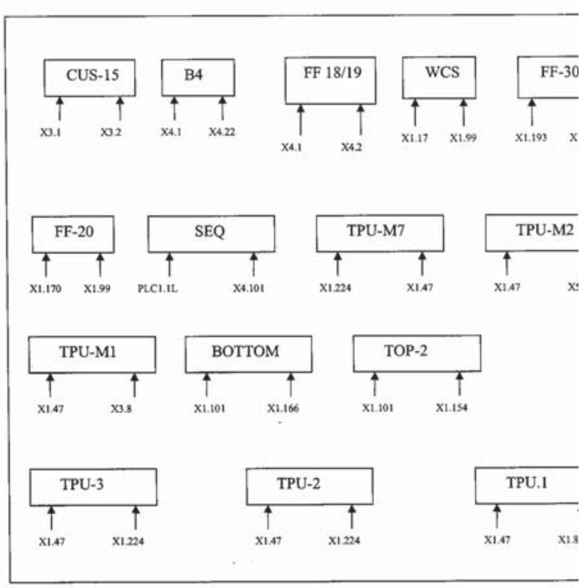


Fig 5.16 Block diagram of LED indications

INDICATION OF LED	SIGNAL TO
F5	Grinder Motor
K6	Brush Motor
K3	Fan Motor
K9	Chute Panel
K18	Philipson Motor

5.2.3 TABLE OF FUNCTIONALITY

Test zig PLC connectins	Connected to	Intermediate points(panel)	Result	Lamp indication
Plc 1-1L	Plc 1-2L	-	-	Supply point
Plc 1-0.0	X4-3	U6-3.0	Delivery speed is measurd	LED 0 of digital input module 3 glows
Plc 1-0.1	X1-124	U6-3.3	-	LED 3 of digital input module 3 glows
Plc 1-0.2	X1-123	U6-3.8	-	LED 7,8 of digital input module 3 glows
Plc 1-0.3	X3-4	S8-1	-	LED 8 of digital input module 3 glows
Plc 1-2L	Plc 1-3L	-	-	Supply point
Plc 1- 0.4	X1-125	U6-3.9	Chute feed/ lap feed	LED 9 of digital input module 3 glows
Plc 1-0.5	X2-7	U6-3.10	-	LED 10 of digital input module 3 glows
Plc 1-0.6	X3-5	U6-3.11	Right hand door 1 & 2	LED 11 of digital input module 3 glows
Plc 1-0.7	X2-6	U6-3.12	Feed pulse	LED 12 of digital input module 3 glows
Plc 1-1.0	X1-166	U6-3.15	Chute feed bottom sensor	LED 15 of digital input module 3 glows
Plc 3L	Exp 1-1L	-		Supply point

Plc 1-1.1	X2-8	K2a-72,X2-8,U6-4.0	Cylinder rotation	LED 0 of digital input module 4 glows
Plc 1-1.2	X3-11	U6-4.1	Flats movement	LED 1 of digital input module 4 glows
Plc 1-1.3	X2-10	U6-4.2	Stripper movement	LED 2 of digital input module 4 glows
Plc 1-1.4	X5-10	U6-4.3	Pressure switch	LED 3 of digital input module 4 glows
Plc 1-1.5	X2-2	U6-4.4	Doffing roller safety	LED 4 of digital input module 4 glows
Plc 1-1.6	X5-8	U6-4.5	Suction flap	LED 5 of digital input module 4 glows
Plc 1-1.7	X4-4	U6-4.6	Can forward	LED 6 of digital input module 4 glows
Exp1-1M	X1-100	U6-1.7 U6-1.10	Double lap sensor LHS, double lap sensor RHS	LED7&10 of digital input module 4 glows
Exp1-1L	Exp 2-1L	-	-	Supply point
Exp1-2.0	X4-3	U6-3.0	Delivery speed	LED 0 of digital input module 3 glows
Exp1-2.1	X4-6	U6-4.8	Can sensor	LED 8 of digital input module 4 glows
Exp1-2.2	X4-7	U6-4.9	Coiler hood	LED 9 of digital input module 4 glows

Exp1-2.3	X4-8	U6-4.10	Limit switch sliver separator	LED 10 of digital input module 4 glows
Exp2-1M	Exp 3-1M	-	-	-
Exp2-1L	Exp 3-1L	-	-	Supply point
Exp2-3.0	X4-9	U6-4.11	Limit switch sliver separator	LED 11 of digital input module 4 glows
Exp2-3.1	X4-10	U6-4.12	Limit switch sliver sensor	LED 12 of digital input module 4 glows
Exp2-3.2	X1-152	U6-4.13	Reed switch sliver separator	LED 13 of digital input module 4 glows
Exp2-3.3	X1-153	U6-4.14	Aerofeed fault	LED 14 of digital input module 4 glows
Exp3-1M	Exp 4-1M	-	-	-
Exp3-1L	Exp 4-1L	-	-	Supply point
Exp3-4.0	X1-154	U6-4.15	Top sensor 1 chute feed	LED 15 of digital input module 4 glows
Exp3-4.1	D O/P 5.0	U17-3	Top sensor 2 chute feed	Feed ON lam in panel glow
Exp3-4.2	D O/P 5.1	U17-1	-	H3 lamp in ji glows
Exp3-4.3	D O/P 5.2	K15(+),Y2A	Top RET zone suction	Y2A lamp in jig glows
EXP4-1M	Exp 4-1M	-	-	
EXP4-1L	Plc 1-0.0	-	-	Supply point
EXP 4-5.0	D O/P 5.3	K16(+)	-	Y.1.2 lamp in jig glows
EXP 4-5.1	X3-10	X2-16,X1-34,F1-2	-	-
EXP 4-5.2	X3-3	X2-1	-	B25 lamp in j glows
PLC 2-1L	Plc 2-2L	-	-	Supply Point
PLC2-0.0	U6.6.0	X2-12	Cyl brake	Y1 lamp in ji glows
PLC2-0.2	U6.6.2	X4-12	Can forward	Y3.1 lamp in

				jig glows
PLC2-0.3	U6.6.3	X4-13	Can reversal	Y3.2 lamp in jig glows
PLC2-0.4	U6.6.5	K1-2	Doffer motor ON	H4a lamp in jig glows
PLC2-0.5	U6.6.6	K2a-61	Cylinder forward rottion	Cylinder ON lamp in panel glows
PLC2-0.6	U6.6.7	K2-61	Cylinder reverse rotation	FF-18/19 lamp in jig glows
PLC2-0.7	U6.6.8	K3-A1	Fan ON	K3 lamp in jig glows
PLC2-1.0	U6.6.9	K4-2	Feed reverse	K4 relay ON
PLC2-3L	U6.6.	-	-	Supply point
PLC2-1.1	U6.6.10	K5-1	Door open	Y6/7 lamp in jig glows
PLC2-1.2	U6.6.11	X5-5	Suction OFF	Y5 lamp in jig glows
PLC2-1.3	U6.6.12	X1-170	Supply to aerofeed	FF20 lamp in jig glows
PLC2-1.4	U6.6.13	X2-14	Philipson brush roller	Y14 lamp in jig glows
PLC2-1.5	U6.6.14	X4-15	Web doffing unit up	Y8.1 lamp in jig glows
PLC2-1.6	U6.6.15	X4-16	Web doffing unit down	Y8.2 lamp in jig glows
PLC2-1.7	X1-167	K10-A1,U6-3.13	Motor overload	LED 13 of digital input module 3 glows

Fig 5.2.3 Table of Functionality

5.2.4 SEQUENCE DIAGRAM AN ITS EXPLANATION

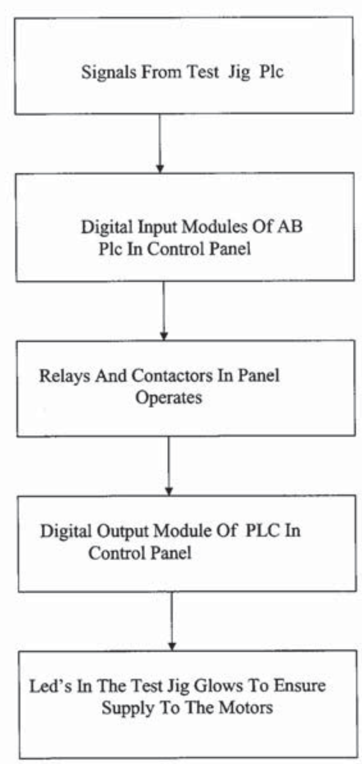
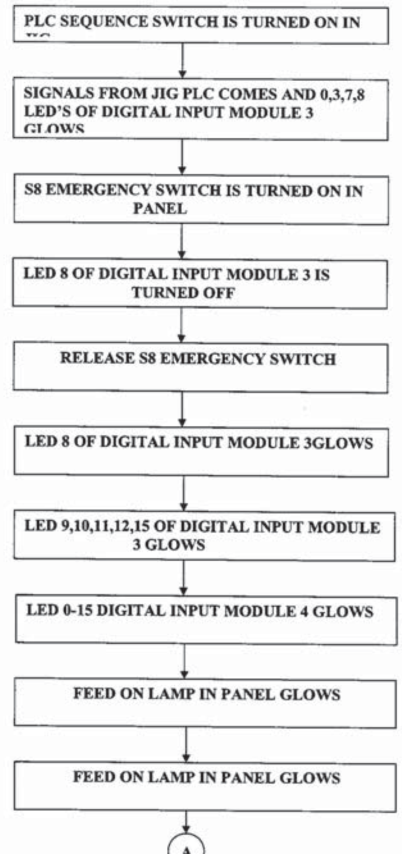


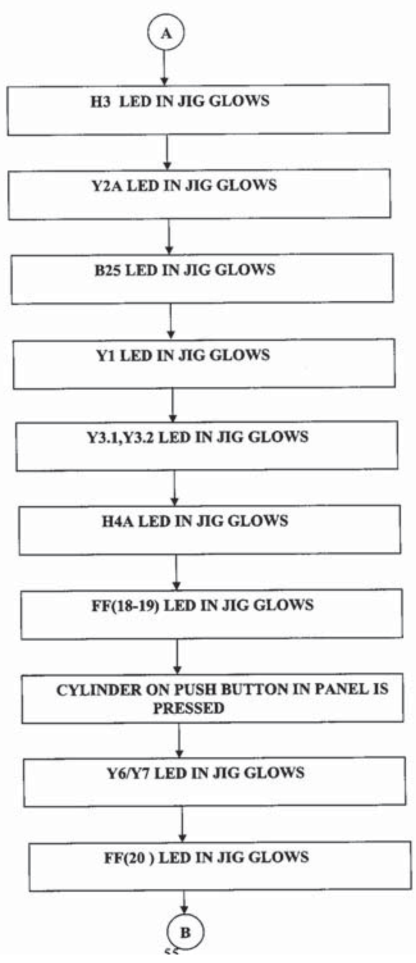
Fig 5.17 Sequence diagram

EXPLANATION

From the above block diagram, it is clear that the signals from the test jig PLC are given to the digital input modules 3 and 4 of the panel PLC. According to the programming of this PLC the relays and contactors in the panel operates and as a result the LED's in the digital output module 5 and relay output module 6 glows. As these contactors closes, the supply is given to the motors which in turn is indicated by the lamps glowing in the test jig.

5.2.5 TESTING FLOW DIAGRAM





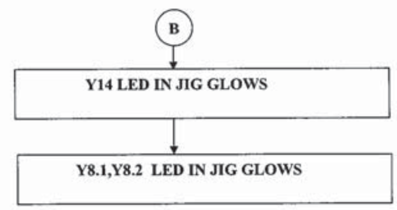


Fig 5.18 Testing flow diagram

5.2.6 TESTING PROCEDURE

The total testing of all the components and its proper operation in the panel tak 8hrs.

It includes the following tests,

1) Panel and test jig initial positions.
2) Electrical functions
   i. Input power supply test.
   ii. DC voltage setting.
   iii. PLC signal test.
   iv. Inverter programming.
   v. Cylinder motor operation.
   vi. Doffer and delivery motor operation etc.,

In this long testing procedure our part is automating the testing of PLC signals.

ADVANTAGES

When performed manually this test goes for around half an hour. On automati the time span is reduced to 7 minutes.

In the manual testing signals to the panel PLC is obtained by manually operati the switches in the test jig. This process consumes lot of time and man power. Tl problem is overcome by replacing the switches by PLC. Hence on implementation of the PLC by turning ON the PLC sequence switch the whole testing process continues and gets over without any interruption.

PLC SIGNAL TEST

The following contactors, relays are ON for 5 sec and OFF for 5 sec in panel and signal lamp also glows for 5 sec and OFF for 5 sec in jig.

Switch ON PLC sequence test switch in jig.

1. "0" LED glows and OFF in PLC digital input-3 module.
2. "3" LED glows and OFF in PLC digital input-3 module.
3. "7" LED glows and OFF in PLC digital input-3 module.
4. "8" LED glows in PLC digital input-3 module.
5. Press S8 emergency switch in panel.
6. "8" LED is OFF in PLC digital input-3 module.
7. Release S8.
8. "8" LED glows and OFF in PLC digital input-3 module.
9. "9" LED glows and OFF in PLC digital input-3 module.
10. "10" LED glows continuously.
11. "11" LED glows continuously.
12. "12" LED glows continuously.
13. "15" LED glows continuously.
14. "0" LED glows and OFF in PLC digital input-4 module.
15. "1" LED glows and OFF in PLC digital input-4 module.
16. "2" LED glows and OFF in PLC digital input-4 module.
17. "3" LED glows and OFF in PLC digital input-4 module.
18. "4" LED glows and OFF in PLC digital input-4 module.
19. "5" LED glows and OFF in PLC digital input-4 module.
20. "6" LED glows and OFF in PLC digital input-4 module.
21. "7" LED glows and OFF in PLC digital input-4 module.
22. "8" LED glows and OFF in PLC digital input-4 module.
23. "9" LED glows and OFF in PLC digital input-4 module.
24. "10" LED glows and OFF in PLC digital input-4 module.
25. "11" LED glows and OFF in PLC digital input-4 module.
26. "12" LED glows and OFF in PLC digital input-4 module.
27. "13" LED glows continuously.
28. "14" LED glows continuously.
29. "15" LED glows continuously.
30. Feed ON lamp glows in panel.
31. H3 lamp glows in jig.
32. K15 relay is ON in panel.
33. -Y2A lamp glows in jig.

34. B25 lamp glows in jig.
35. Y1 lamp OFF in jig.
36. Y3.1 lamp glows and OFF in test jig.
37. Y3.2 lamp glows and OFF in test jig.
38. K1 relay is 0FF.
39. -Doffer is ON & OFF in the panel & H4a is OFF in the jig.
40. K2 contactor switch is 0N.
41. -Cylinder ON push button glows in panel.
42. -FF(18-19) glows in jig.
43. K2 contactor is OFF.
44. -Cylinder ON push button lamp is OFF in the panel.
45. -FF(18-19) glows in the jig.
46. K2 contactor is ON.
    - Cylinder ON push button lamp glows in the panel.
47. K2 contactor is OFF.
    - Cylinder ON push button lamp is OFF in the panel.
48. K4 relay is ON and OFF.
49. K5 relay is ON.
50. -Y6/Y7 lamps glows in jig.
51. K5 relay is OFF.
    - Y6/Y7 lamps are OFF in jig.
52. FF(20) lamp glows and OFF in jig.
53. Y14 lamp glows and OFF in jig.
54. Y8.1 lamp glows and OFF in jig.
55. Y8.2 lamp glows and OFF in jig.
56. K10 contactor is ON & OFF.
57. -"13" LED glows and OFF in PLC digital input-3 module.

CHAPTER 6

CONCLUSION

6.CONCLUSION

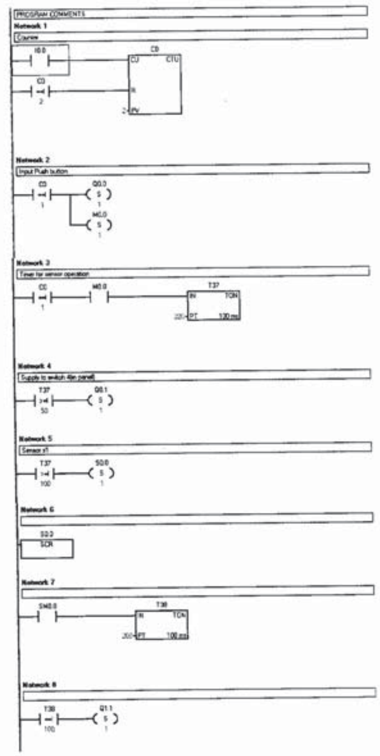
We have automated the testing of aero feed and carding panel by using PLC programming. The software used is SIEMENS (S7200). The sequence of testing is programmed and switches are used to give input for the PLC. After certain period of tim the components and its continuity is checked automatically and output is confirmed by the indication of lamps. Thus by using automation, the time consumed for testing these panels have been considerably decreased and in turn production of aero feed and carding panel in industries are further increased.

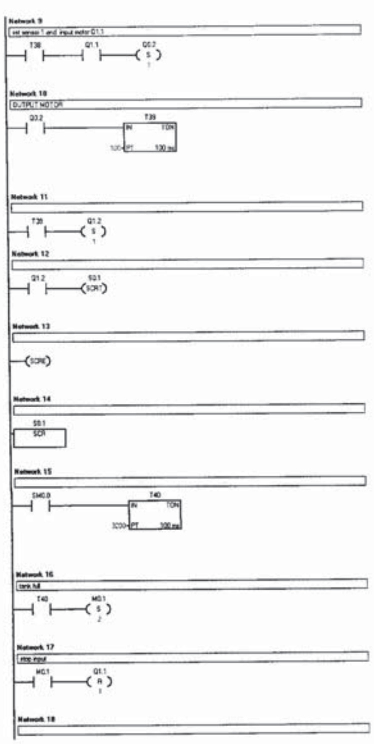
FUTURE SCOPE

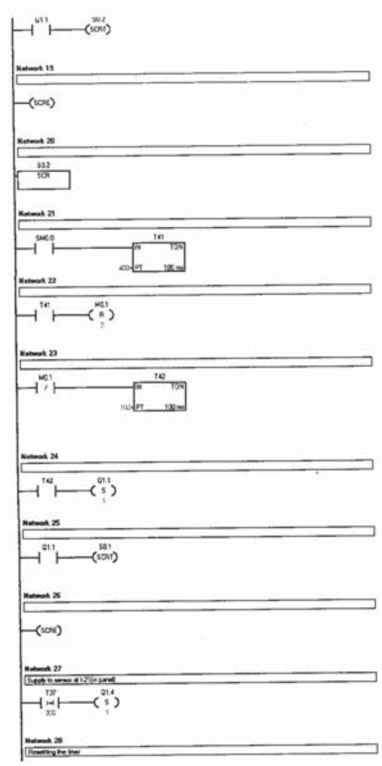
We have automated a part in the entire testing process. Still the remainin processes which are tested manually can be automated using PLC in the similar manne By doing so, the time taken for testing the entire panel gets reduced considerably enablin the process to be more efficient

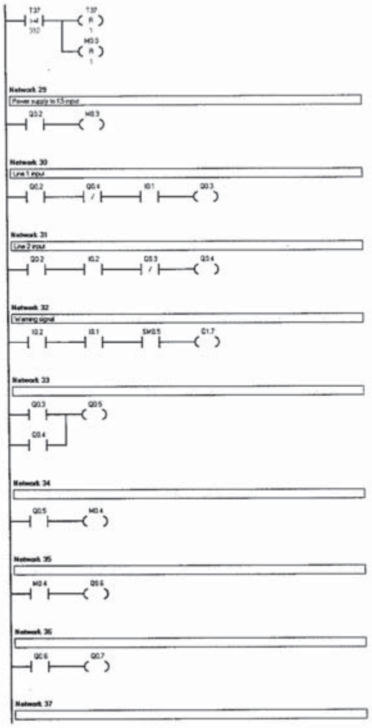
APPENDIX A : PLC PROGRAMMING

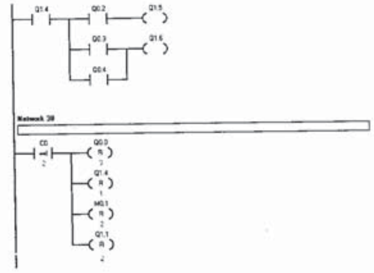
PROGRAM - AEROFEED PANEL



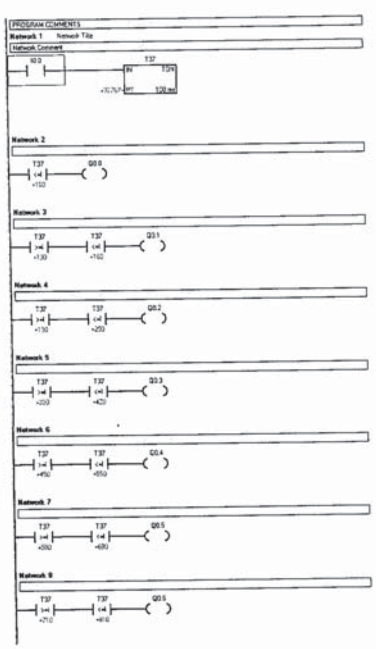


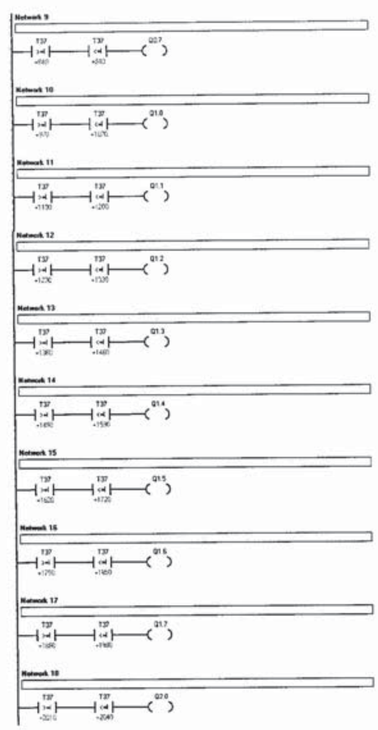


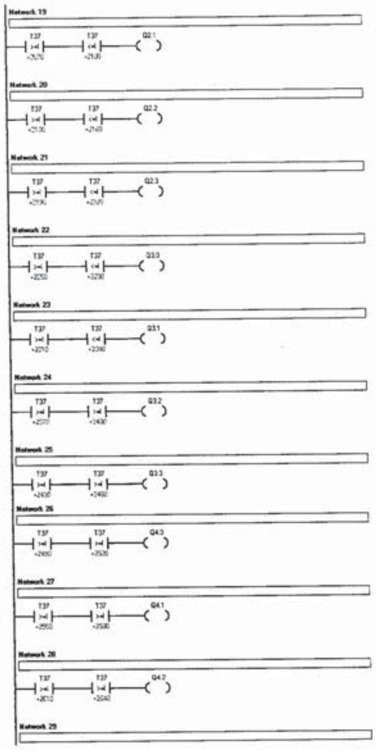


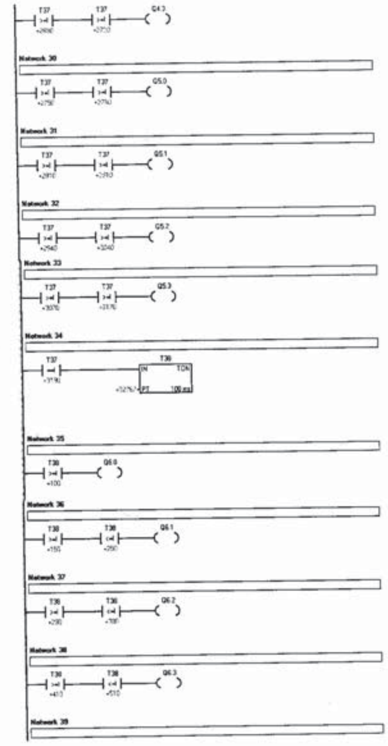


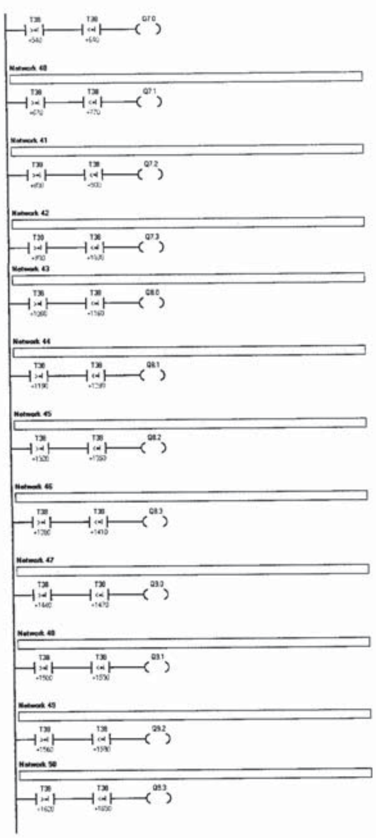
PROGRAM - CARDING PANEL











APPENDIX B : DATA SHEETS

APPENDIX B : DATA SHEETS

Danfoss VLT 2800 Inverter Drives

The VLT® 2800 series is among the smallest multi purpose drives in the market. Designed for space saving side-by-side mounting. Choose to have it with e.g. Motor Coils, RFI filter, LC+1B filters.

The VLT 2800 is an advanced and versatile drive, easy to operate.

The quick menu includes all parameters basically needed for commissioning the drive. Offers fast installation and service

Ne
ad
D
280
or
dr

Call
H
CS
(
on 0

Product Range

0.55 – 18.5 kW
(3 phase 380 - 480 V ± 10 %; 50/60 Hz)
0.37 - 1.5 kW
(Combined 1 and 3 phase 200 - 240 V ± 10 %; 50/60 Hz)
2.2 - 3.7 kW
(3 phase 200 - 240 V ± 10 %; 50/60 Hz)

Variable output frequency between 0 and 1000 Hz

Product safety

100 % short-circuit proof
100 % earth fault protection
Mains transient protection
Switching on input
Switching on output
Galvanic isolation
Designed according to EN 50178

Speed compensation precise stop

Better process control
Same stopping distance independent of initial motor speed

Precise stop

Interrupt controlled stop
Higher process repeatability
Well defined stopping

Counter stop

Accurate positioning
High frequency input (65 kHz)
24 V incremental encoder input
AB encoder input as option

Automatic motor tuning

Perfect match between motor and drive
Measures the stator resistance (RS)
Better shaft performance
Measurements done without applying torque
Checks for missing motor phases

Flexible mounting

Horizontal mounting
Vertical mounting
True side-by-side mounting
No derating
Also applies to modules
Temperature controlled fan

Cold plate technology

Reduced heating in cabinet
Denser installation
Higher enclosure class cabinets
Protection against:
- Dust
- Dirt
- Humidity
Heat dissipates through the back of the dri

Communication

DeviceNet
ModBus RTU
Profibus DP, optional

Fieldbus systems
Profibus DP 3 or 12 Mbit/s
Up to 127 nodes per installation
Homepage: www.profibus.com
DeviceNet Up to 500 kbit/s
Up to 64 nodes per installation
Homepage:www.odva.com

EMC filter and DC coils

Compliance with EMC Standards.
Built-in EN 55011 1A filter, 25 m screen
No EMC disturbance.
EN 55011 1B filter available as module.
IT mains compatible version with RFI fil
kW).
VLT 2880-2882 with RFI-switch.

Braking facilities

DC-braking - approx. 20% braking torqu
AC-braking - approx. 20% braking torqu
Dynamic braking
- Brake chopper built-in
- 160% braking torque
LCP2 Alpha numeric display, with copy
MCT10 software

Danfoss VLT 2800 Series Options

VLT Type	Typical Shaft Output (kW)	Cont. Output current (Amps) @ 208 240V	Input 50/60Hz [illegible]	Ou... IP2...
VLT 2803	0.37	2.2	240V, 1PH	
VLT 2805	0.55	3.2	240V, 1Ph	
VLT 2807	0.75	4.2	240V, 1Ph	
VLT 2811	1.10	6.0	240V, 1Ph	
VLT 2815	1.50	6.8	240V, 1Ph	

VLT Type	Typical Shaft Output (kW)	Cont. Output current (Amps) @ 380 415V	Input 50/60Hz IP20	Outp...
VLT 2805	0.55	1.7	400V, 3Ph	40
VLT 2807	0.75	2.1	400V, 3Ph	40
VLT 2811	1.10	3.0	400V, 3Ph	4(
VLT 2815	1.50	3.7	400V, 3Ph	4(
VLT 2822	2.20	5.2	400V, 3Ph	4(
VLT 2830	3.00	7.0	400V, 3Ph	4(
VLT 2840	4.00	9.1	400V, 3Ph	4
VLT 2855	5.50	12.0	400V, 3Ph	4
VLT 2875	7.50	16.0	400V, 3Ph	4
VLT 2880	11.00	24.0	400V, 3Ph	4
VLT 2881	15.00	32.0	400V, 3Ph	4
VLT 2882	18.50	37.5	400V, 3Ph	4

VLT 2800 General Options

Part Number	Description	Used
175N0131	LCP2 Control Unit (IP.65)	All
175Z0850	Remote mounting kit for LCP (includes 3m cable)	All
175Z0929	Cable for LCP - 3 m (Also included in remote kit)	All
175N0128	L O P (Local Operating Pad) - includes cable	All
195N3113	Cable for 'DeviceNet' Connection	All
195N1900	NEMA 1 Terminal Cover - Used on: VLT 2803 - VLT 2815 (200 - 240V) VLT 2805 - VLT 2815 (380 - 480V)	Call
195N1901	NEMA 1 Terminal Cover - Used on: VLT 2822 - (200 - 240V) VLT 2855 - VLT 2875 (380 - 480V)	Call
195N1902	NEMA 1 Terminal Cover - Used on: VLT 2840 - (200 - 240V) - VLT 2855 - VLT 2875 (380 - 480V)	Call
195N3110	Motor coil module	All
195N3103	1B RFI Filter Module	All
195N3100	1B RFI / LC Filter Module - 4 amps VLT 2803 - VLT 2805 (200 - 240V) VLT 2805 - VLT 2815 (380 - 480V)	Call
195N3101	1B RFI / LC Filter Module - 9.1 amps VLT 2807 - VLT 2815 (200 - 240V) VLT 2822 - VTLT 2840 (380 - 480V)	Call

APPENDIX C : PHOTOS

AEROFEED CONTROL PANEL

AEROFEED PANEL – TEST JIG

CARDING PANEL

CARDING PANEL – TEST JIG

LED INDICATIONS – CARDING PANEL TEST JIG

REFERENCES