APPENDICES

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APPENDIX A

GLOSSARY

Accumulated value - the value of a timer or counter at any given time during its operation.

Address - the number given to an element in a ladder logic diagram which distinguishes it from any other element.

Alphanumeric - a character string comprised of numbers and letters.

ALU - see **arithmetic logic unit**.

AND - the Boolean relationship in which two elements must be true at the same time for the outcome to be true.

Arabic numerals - the digits 0, 1, 2, 3, 4, 5, 6, 7, 8, 9.

Arithmetic logic unit - ALU - the section of the processor which solves arithmetic problems and makes logical decisions.

Base 2 - number system based on the digits 0 and 1; **binary number system**.

Base 8 - number system based on eight digits 0,1,2,3,4,5,6,7; **octal numbering system**.

Base 10 - number system based on the ten Arabic symbols, 0,1,2,3,4,5,6,7,8,9; **decimal number system**.

Base 16 - alphanumeric system which uses Arabic numerals plus the letters A,B,C,D,E,F to represent binary numbers; **hexadecimal number system**.

Binary system - base 2 numbering system which uses only 0 and 1; used to represent on/off electrical states in computer operations.

Bit - a single unit of information available to a computer; represents the status of an input in a PLC, with 0 = OFF and 1 = ON.

Boolean Algebra - a mathematical system which represents logical relationships in terms of equations; used in logical decision making.

Branch - represents alternative (OR or parallel) inputs in a ladder logic diagram.

Cascading timers - timers operating in a series such that each timer acts as an input to begin the operation of the next timer in the series.

Central processing unit - CPU - the section of the PLC responsible for making decisions about what the ALU and memory should be doing, and when.

Coil - relay element.

Command - instruction to the controller to perform a particular operation with the program.

Condition - requirement which must be satisfied in a logical relationship or decision.

Conditional rung - any rung on which an input element controls the status of an output element.

Controller - the central part of the PLC which houses the central processing unit, memory and arithmetic logic unit.

Counter - an event driven relay which activates its outputs after its input has been energized a preset number of times.

CPU - see **central processing unit.**

Decimal system - the base 10 numbering system used for daily arithmetic operations.

Display screen - the section of the programming pendant which shows the elements, their status, and other data during operation of the PLC.

Editing functions - functions of the PLC which allow the user to modify programs; they include search, insert, and remove for elements and rungs (see Appendix B for function descriptions).

EEPROM - a removable computer chip used for permanent or long- term storage of a PLC program, or for creating multiple copies of a PLC program.

Element - any input or output on a ladder logic diagram.

Energized - input element has power to it.

Event driven sequencer - a sequencer which operates like cascaded counters, activating its outputs after its input is energized a preset number of times.

Examine-off element - an input element which activates its output when it has been de-energized; a **normally closed input element.**

Examine-on element - an input element which activates its output when it has been energized; a **normally open input element.**

Force - monitoring function which allows operator to change the status of an input or output element.

Hard-wired - electrical connection which is permanently wired.

Hexadecimal system - the base 16 alpha-numeric system used to convert binary numbers into simpler codes.

Home - the user-defined starting position of a movable device controlled by a PLC, such as a robot arm.

Input device - any device external to the PLC, such as a switch, which is used to activate an input on the PLC.

Input module - the part of the PLC which houses the connections between the input devices and the processor of the PLC.

Internal relay - a type of output element which allows one set of input elements to control one or more other rungs of the ladder logic diagram.

Keypad - the section of the programming pendant which holds the keys used to enter programs and other instructions.

Ladder logic diagram - the diagram which displays symbolic inputs and outputs representing the operations of the controller.

Ladder mode - pendant operating mode in which programming, editing and monitoring functions are executed on a ladder logic diagram.

Latching circuit - a circuit which employs parallel input elements to hold an output activated, even when the input element which activated the output is no longer energized; requires an **unlatching element** to unlatch the circuit during program operation.

Latching element - an input element which is held in the energized state within the program until it is instructed to unlatch by a second input element.

LED - see **light emitting diode**.

Light emitting diode - **LED** - an electronic device which emits small amounts of light when activated.

Logical decision - a decision which allows for only two possibilities, True or False, resulting from the conditions affecting the decision.

Logical inverse - see **NOT**.

Maintain switch - a switch which, when changed from open to closed or from closed to open, holds its changed state.

Master control relay - an internal relay in a PLC which controls all outputs within its zone, turning off non-retentive outputs and holding retentive outputs in their last states; also called override instruction or step instruction.

MCR - see **master control relay**.

Memory - the part of the controller which retains instructions about controller and program operation; it is divided into RAM and ROM.

Mode - the instruction used to tell the controller the general form of operation, such as run, stop or monitor.

Momentary switch - a switch which, when normally open, must be held in the closed position, or when normally closed, must be held in the open position; it returns to its normal position when released.

Monitoring functions - functions in the PLC which allow the user to observe the status of inputs and outputs during running of a program; they include search commands.

Non-retentive - refers to any element, such as a internal relay, which resets when it is de-activated.

Normally closed input element - any contact whose normal state is energized.

Normally closed switch - the contacts on the switch are closed and electricity can flow through the switch until the switch is pressed.

Normally open input element - any contact whose normal state is not energized.

Normally open switch - the contacts on the switch are open and no electricity can flow through the switch until it is pressed.

NOT - the logical relationship of negation; defines the opposite of the element in question. Ex: if A is true the A is false.

Octal system - the base 8 numbering system used to address PLC elements.

Operation holding instruction - any program instruction which holds its output activated, even when the input which activated the output is no longer energized.

Opto-isolator - an electronic device comprised of an LED and a photo-transistor used in some PLCs to separate the CPU from external power supplies.

OR - the logical relationship in which one of two conditions must be satisfied for the outcome to be true.

Output device - any external device, such as a light or valve system, which responds to the controls of a PLC.

Output module - the section of the PLC which connects the processor to the output devices.

Override instruction - see **master control relay**.

Parallel circuit - an electrical circuit in which inputs and/or outputs are ORed together; an electrical circuit in which there is more than one path through which the current can flow.

Photo-transistor - a light sensitive switch used within an opto-isolator.

PLC - see **programmable logic controller**.

Pneumatic - air powered.

Power supply - any source of electrical power for a circuit.

Preset value - the value used to instruct a timer or counter when it should activate its outputs.

Processor - the central computer in the PLC which examines the status of inputs and changes output status according to program requirements.

Program - the set of commands entered into the PLC to tell it how to respond to input status changes.

Programmable logic controller - a device which uses a computer to turn outputs on and off in response to inputs being turned on and off; consists of an input module, output module and controller.

Rail - the two vertical lines in a ladder logic diagram used to represent the power supply to the circuit being programmed.

RAM - see **random access memory**.

Random access memory - RAM - that part of a computer's or controller's memory which stores information during programming for use during operation; it holds the instructions which can be changed from operation to operation, such as element addresses.

Read only memory - ROM - the part of a computer's or controller's memory which holds the permanent instructions to the computer, such as what a particular keystroke signifies or what the unacceptable commands are.

Rectifier - device which converts alternating current to direct current.

Register table - the area of a PLC's memory which stores the status of inputs and outputs; it is made up of a matrix of cells with addresses, each of which stores one bit of information.

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Relay - an electro-mechanical device use to turn an output on or off in response to the activation or de-activation of input devices.

Resistor - device used to control the flow of electrical current.

Retentive - refers to any element, such as a counter, which stores its accumulated value or holds its last state when stopped and begins its operation in its last state when re-activated; such an element must be specifically reset to return to an off status or the beginning of its operating cycle.

ROM - see **read only memory**.

Roman numerals - numbering system which uses letters to represent numbers, so that I = 1, IV = 4, XII = 12, etc.; has no symbol for zero.

Rung - the horizontal lines in a ladder logic diagram which hold the inputs and outputs for the PLC program.

Scan time - the amount of time it takes the PLC's processor to examine the status of each input element and to enter the status of the output elements into the register table in response to program requirements.

Sequencer - a PLC function which allows a single input to control a series of outputs; programmed in steps which are either event or time driven.

Series circuit - an electrical circuit in which inputs and/or outputs are ANDed together; there is only one path through which the current can flow.

Shift register - a PLC function which moves a bit of information through a specified series of output addresses in a set order.

Status - the condition, on or off, of an element in a PLC program; also called state.

Step instruction - see **master control relay**.

Terminal - electrical connection in a hard-wired circuit; in particular, the point at which external input and output devices are wired to the controller body.

Time driven sequencer - a sequencer which increments through its steps after preset time intervals.

Timer - a relay which changes the status of an output after a preset time interval.

Truth table - a listing which shows the state of a given output as a function of all possible input combinations; used in **Boolean Algebra**.

Unconditional rung - a rung which has no input element controlling its output element; the rung is operational the entire time the program is running.

Unlatching element - the output element used as a contact to de- activate a latched relay.

User memory - the memory where the PLC program is stored; see also **random access memory**.

ZCL - see **zone control relay**.

Zone - the sequence of rungs controlled by a master control relay; it includes all rungs between the beginning rung of the master control relay and the ending rung of the master control relay.

Zone control relay - an internal relay in the PLC which controls all outputs within its zone; when de-activated, it locks the outputs in their last state.

APPENDIX B

FUNCTIONS, ADDRESSES AND MODES

Function Description:

1. -(CTU)- - Counter Up.

2. -(CTD)- - Counter Down

3. EVENT- Specifies an event driven sequencer.

4. —||— Examine if Open – Input Off

    —| |— Examine if Closed – Input On

5. -(MCR)- - Master Control Relay.

6. NEW RUNG - For adding or inserting a new rung.

7. Numbers- Used to identify elements and preset values.

8. -( )- - Output or internal relay

9. -(SQO)- Output sequencer

10. -(SQC)- Sequential Compare

11. -(SQL)- Sequential Load

12. -(RES)- Reset

13. -(TOF)- Retentive Timer Off Delay

14. -(TON)- Retentive Timer On Delay.

15. TIME - Specifies a time driven sequencer.

16. -(RES)- Reset

17. -(CTU)- Up Counter

Addresses:

I:0/0 - I:0/7	External Inputs
O:0/0 - O:0/5	External Outputs
B3:0/0 -B3:31/15	Internal Relays
C5:0 - C5:39	Counters
T4:0 – T4:39	Timers
R6:0 – R6:15	Sequencers

Mode Descriptions:

1. **OFFLINE:**
    The OFFLINE program mode allows you to modify your program, edit data and transfer programs to and from the memory module. In this mode the processor does not scan or execute the ladder program and all outputs are de-energized.

2. **RUN:**
    The RUN command executes the program in RAM; permits user to monitor status of elements during operation.

4. **Test Continuous Scan:**
    This test mode is the same as the remote run mode except output circuits are not energized. This allows the trainer to troubleshoot or test a program without energizing external outputs devices on a continuous basis.

5. **Test Single Scan:**
    In this test mode, the controller executes a single operating cycle that reads the inputs, executes the program, updates all the data without energizing output circuits.

APPENDIX C
REPLACEMENT PARTS LIST

Component ID	Component Description	Qty. Needed
000.000SSN	Serial Number Label	1
000.000650	MB650 Case Label	1
000.042020	24VDC Power Supply	1
000.042021	Fuse Holder	2
000.088009	Fuse 1 Amp	2
000.090022	Patch Cord (4")	4
000.090024	Patch Cord (18")	2
000.091001	Red Led	20
000.091002	Yellow LED	2
000.091003	Green LED	2
000.091004	LED Socket	26
000.092014	Push Button Switch	1
000.092025	Pilot Lamp 125V Amber	2
000.092026	Pilot Lamp 28V Amber	1
000.092027	Toggle Switch	2
000.092117	White Jack	41
000.092118	Green Jack	26
000.092119	Red Jack	3
000.092120	Black Jack	3
000.092121	Banana Plug	4
000.092122	Momentary Switch	4
000.092123	Alternative Switch	4
000.092124	Red Bezel	2
000.092125	Yellow Bezel	2
000.092126	Green Bezel	2
000.092129	White Bezel	2
000.092130	Patch Cord (8")	6
000.092131	Light Bulb 28V	8
000.092132	Cross Patch (12)	4
000.092200	5" Al. Screw Post	2
000.092201	1/4-20 X 5" Al. Stud	1
000.092201	Large Gear	1
000.092205	Small Gear	1
000.092206	Timing Belt	1
000.092209	DC Motor	1
000.092211	MB655 Front Panel	1
000.092212	5VDC Internal Power Supply	1
000.092214	24VDC Relay	4
000.094010	8' Line Cord	1
000.094100	Sm Plastic Cord Grip	1
651.096053	Controller MB650ML	1
ELE.028001	MB100 Frame	1
ELE.029001	AC Connector	1
ELE.029002	Power Cord	1
ELE.036001	Sensor	6