2004 CSI PROCUREMENT SPECIFICATION

For the MicroLogix 1500 Programmable Controller

Allen-Bradley MicroLogix 1500 Product Note

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The illustrations, charts, and examples shown in this document are intended solely to illustrate the principles of programmable controllers and some of the methods used to apply them. Particularly because of the many requirements associated with any particular installation, Rockwell Automation cannot assume responsibility or liability for actual use based upon the illustrative uses and applications.

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Part 1 General

1.01 Definitions

The following terms are used in this document.

Packaged Controller	A programmable controller that has all of the required components in one package (inputs, outputs, power supply, memory, processor, communication ports, etc.). Certain packaged controllers can (and do) provide expansion through the use of expansion modules.
Modular Controller	Programmable controller comprised of individual components (racks, power supplies, processors, Input modules, Output modules). The components are purchased and assembled to create an operational controller.
Control System	Equipment that controls the application. Includes panel, electrical hardware (terminal blocks, rails, wiring systems), field devices (sensors, switches, motors, transmitters, etc.), Programmable controller components, etc.
I/O	Input circuits and output circuits. Typically in reference to the programmable controllers inputs and outputs.

1.02 General Specifications

A. This specification has been developed to establish minimum requirements for a solid-state programmable controller designed to provide high reliability in electrical control applications. The internal “wiring” of the controller is to be fixed, with the logic functions it must perform in a given application to be programmed into its memory. The control system shall be supplied with the Controller and all power and interface cables necessary to function as a complete and operable controller system.

B. The objective of the packaged controller will be to improve reliability, maintainability, and efficiency by reducing operating costs and downtime.

C. The specification shall be followed in accordance with the contract and all areas of questions or noncompliance shall be submitted to the purchaser for review and approval.

1.03 Service

A. The supplier shall provide operating instruction manuals with adequate information pertaining to the following:

- System specifications
- Electrical power requirements
- Application considerations
- Assembly and installation procedures
- Power up procedures
- Troubleshooting procedures
- Programming procedures
- Explanation of internal fault diagnostics
- Shut down procedures
- Recommended spare parts list

B. In cases where the programming is done by the supplier, the supplier shall provide a copy of all working programs on CD/DVD, as well as a printed program listing.

C. The supplier shall provide a network of field sales and support personnel located in key cities throughout the United States and internationally. The supplier shall also provide a field service department with experienced representatives stationed in major cities with the capability to provide telephone consultation, prompt on-site service, and field replacement stock.

D. The supplier shall provide product application assistance by trained and experienced engineers to assist the customer with program and system development and maintenance through telephone consultation, on-site check-out, debug, and start-up assistance.

E. The supplier shall provide a customer training program designed to teach the customer's personnel in the understanding and application of the control system. The training program shall include training manuals and "hands-on" programming experience on a packaged controller of a type similar to that provided by the supplier.

F. The supplier shall have the capability to conduct on-site training programs at a location provided by the customer.

Part 2 - Products

2.01 Assembled Systems

A. A supplier shall assume single source responsibility for system assembly. An assembled system may include mounting and wiring of relays, motor starters, transformers, and disconnecting means, or other control devices as specified by customer-supplied documentation.

B. The supplier shall provide mounting and wiring of the control system in a NEMA type 12 or other enclosure that may be specified by the customer.

C. If specified, the enclosure shall be able to accommodate an electrical service of 460V, 3-phase, 60 Hz. The enclosure shall have sufficient room for a 460V AC (primary) to 115V AC (secondary) control transformer to service the processor, inputs, and outputs.

D. The supplier shall be able to provide a sealed plastic window in the NEMA 12 enclosure door(s) for observing the controller status and I/O indicators.

E. The supplier shall have the capability to supply an enclosure with special paint and graphic displays.

F. The supplier shall have the capability to wire all controller inputs and outputs to customer-specified terminal blocks.

G. The assembled system shall include fuse blocks as sized by the customer's application.

H. Within the enclosure all electrical control products shall be grounded to meet controller specifications.

I. The supplier shall be able to provide within the enclosure a master control relay to de-energize all I/O circuits. The master control relay must be de-energized directly by a hardwired Emergency Stop pushbutton.

J. All pushbuttons, switches and other operator devices must be UL listed and/or CSA approved.

K. All pushbuttons, switches and other operator devices must be sufficiently large (customer approved) and durable to provide dependable, long life operation.

L. All cables (with associated plugs, connectors, and receptacles) requiring user field installation shall be designed for commercial use to withstand an industrial environment.

M. Upon receipt of the purchase order but prior to starting the manufacture of the equipment, the supplier shall submit drawings of the complete assembled system for approval by the customer or their consultant.

N. Drawings which are returned to the supplier for correction or revision shall be resubmitted for approval before fabrication, unless the work in question is marked by an approved representative with "approved as noted."

O. All drawings shall include page, sheet, and line numbers.

P. The first page of all drawings and schematics shall be a cover sheet consisting of a Bill of Material, purchase order number, manufacturer's job number, user's name, location, application, and shipping address.

Q. The drawings shall include a mechanical layout detailing the overall external dimensions of the enclosure. The drawings shall include such pertinent information as location of door handles, windows, lifting lugs, and enclosure mounted items such as tachometer or current meters, cooling fans, etc.

R. The supplier shall provide documentation detailing the mounting of the processor, I/O expansion I/O, motor starters, disconnect switch, fuse blocks, wireways, etc. All materials shall be labeled to provide easy cross-reference to the Bill of Material listing.

S. Electrical prints detailing all hardwiring, done by the supplier, to devices such as relays, motor starters, disconnect switches, fuse blocks, etc. shall be provided with individual wire numbers and relay contact cross-reference designations.

T. Sections describing inputs shall designate input name, and terminal location.

U. The last sheet in the set shall be for terminal block designations each containing their individual terminal numbers.

V. At the time the equipment is shipped, one reproducible copy of each drawing mentioned above shall be provided with the equipment.

2.02 Design Description

A. A major consideration of the controller system shall be its all-in-one design, with I/O expansion so the user can quickly and easily install, service and replace the controller and expansion modules, if necessary. The supplier must have available a number of I/O options for the controller that include:

1. Power: 120V AC, 24V DC
2. Inputs: 120V AC, 240V AC, 24V DC sink, 24V DC source, 4-20 mA Analog , 0-10V Analog, RTD and Thermocouple
3. Outputs: Relay (some of which must have individual isolation), 24V DC source, 4-20 mA Analog, 0-10V Analog and TRIAC

B. The controller must be part of a larger family of packaged and modular programmable controllers that provide program transport (ability to move a customers program between platforms in both directions), and also share programming tools, a common instruction set, and common communications to serial based devices (computers, electronic operator interfaces, etc).

C. All hardware of the controller shall operate at an ambient temperature of -20° to 60° C (-4° to 140° F), with an ambient temperature rating for storage of - 40° to +85° C (- 40° to 185° F).

D. The controller hardware shall function continuously in the relative humidity range of 5% to 95% with no condensation.

E. The controller shall have at least two dedicated serial ports which support RS-232-C signals. These ports must be capable of local and remote (via modem) programming, troubleshooting and data manipulation.

F. The controller shall have at least one dedicated serial port which supports RS-485 signals. This port must be capable of local and remote programming, troubleshooting and data manipulation.

G. The controller shall have at least one RJ-45 port which supports 10/100 Mbps EtherNet/IP. This port must be capable of local and remote programming, troubleshooting and data manipulation.

H. The controller system shall be designed and tested to operate in high electrical noise environments, and must meet or exceed:

- EN 61000-4-2 (ESD Immunity)
- ENV 50204 (Radiated Immunity)
- EN 61000-4-3 (Radiated RF Immunity)

- EN 61000-4-4 (Fast Transient Immunity)
- EN 61000-4-5 (Surge Transient Immunity)
- EN 61000-4-6 (Conducted RF Immunity)
- EN 55011 (Conducted and Radiated Emissions)
- EN 61000-4-11 (Line Related Tests)

2.03 Main Hardware

A. The CPU shall be a self-contained unit and be capable of displaying Ladder Rung program execution through its RS-232/RS-485 and EtherNet/IP communication ports. The CPU will control all I/O scanning and communications servicing.

B. All components of the controller system shall be housed in a single chassis (power supply, embedded I/O circuitry, CPU, Memory and communications shall reside in one enclosure).

C. The CPU within the system shall perform internal diagnostic checking and give visual indication to the user by illuminating a “green” indicator when no fault is detected and a “red” indicator when a fault is detected.

D. The packaged controller shall be designed to operate in a free air flow environment (convection cooling only, no fans or other air moving devices shall be required).

E. The controller shall provide a simple embedded Human Machine Interface (HMI). This HMI must provide the ability to monitor/change user data and also to display messages and data to the user. The ability to receive numeric input from the HMI which can be utilized by the controller’s program must also be supported.

F. The controller must provide a mechanism to manually set the communication port to a known state (factory out-of-box preferred). Systems that do not provide a mechanism to manually set the communications port to a known state are not acceptable.

G. The controller must provide at least two digital trim potentiometers that are accessible from the front of the controller while the controller is operating.

H. The controller must support front accessible memory modules that can be inserted or removed while the system is operating (in run).

I. The main front panel of the controller shall include the following indicators: Power, Run, Fault, and Force.

J. Processor mode shall be selected by a command from a programming device. Available settings must include modes:

RUN	Control program executing
PROGRAM	Controller not executing, user program can be uploaded or downloaded
SINGLE SCAN TEST	The PLC scans and solves the user program once, does NOT control the real world outputs, and stops.
CONTINUOUS SCAN TEST	The PLC continuously scans the user program but does NOT control the real world outputs.

K. Non-volatile memory shall store the operating system, user program, and all user data to protect against memory loss in the case of power loss or system shut-down.

2.04 Power

A. The packaged controller shall operate in compliance with one of two types of electrical service:

- 120/240 V AC, single phase, in power systems that operate on 50/60 Hz. It must be capable of auto-detect to operate with either of these AC voltages or frequencies without the user needing to jumper or setup the unit.
- 24V DC Class 2 SELV

B. All AC powered controllers with 24V DC inputs must be capable of supplying a minimum of 24V DC at 200 mA. This can be used to provide external 24V DC power for input devices (sensors, switches, etc.).

C. The onboard power supply must be capable of supplying all necessary power to all subsystems (CPU, Memory, local I/O, etc.) plus a minimum of seven expansion I/O modules without external wiring.

D. The power supply shall provide surge protection, isolation, and power outage carry-over of at least one cycle of the AC line.

E. In cases where the AC line is especially unstable or subject to unusual variations, it shall be possible to install a constant voltage transformer having a sinusoidal output waveform.

F. At the time of power-up, the power supply shall inhibit operation of the processor and I/O modules until the DC voltages are within specifications.

2.05 Program Storage

A. The program storage medium shall be a solid state non-volatile type.

B. The controller shall be capable of addressing up to a minimum of 10K data words, where each word is comprised of 16 data bits.

C. Available user memory shall consist of a minimum of 20K words of program and data.

D. Controller shall support up to 128K bytes for data logging.

E. Controller shall support up to 64K bytes for recipe storage.

F. The controller must provide the capability to use a non volatile memory module that can be inserted or removed while power is applied to the controller.

G. The memory module must support the ability to selectively protect multiple areas of user data from being overwritten if/when a download occurs.

H. Memory modules must be capable of write once read many operations. This is a write once feature that if enabled inhibits a user from clearing the program currently stored in the memory module.

I. The memory module must support automatic program download whenever power is applied.

J. The memory module must support the ability to detect if a fault is present during the power up sequence, if a fault is present download the program that is in the memory module and enter the run mode. If a fault is not present the controller proceeds normally without memory module intervention.

K. The operator should be able to backup memory, including data and program logic onto a CD, DVD, hard disk, or memory module.

L. The packaged controller system must be capable of storing the following data:

- External Output Status
- External Input Status
- Timer Values
- Counter Values
- Signed Integer Numbers (16-bit)

- Signed Integer Numbers (32-bit)
- Binary data (bit, BCD, HEX)
- ASCII String Data
- Internal Processor Status Information

M. The above listed data shall be distinguishable to the CPU by the addressing format. Management of the data into memory subsections shall be an automatic function of the CPU operating system. Data can be displayed in Binary, Hexadecimal, or Decimal. Function-specific data such as processor status shall have dedicated displays that annotate the meaning of specific control bits and words within them and allow for selective control where appropriate.

N. If contacts or entire rungs are intentionally deleted from an existing logic program, the remaining program shall be automatically repositioned to fill this void. Whenever contacts or entire rungs are intentionally inserted into an existing program, the original program shall automatically be repositioned to accommodate the enlarged program.

O. The controller must support a minimum of 12 pulse inputs. Pulse inputs allow a fast signal to be captured and held long enough for the controller to detect the signal, once read the signal is automatically reset.

P. The number of times that a normally open (N.O.) and/or normally closed (N.C.) contact of an address can be programmed shall be limited only by the memory capacity to store these instructions.

Q. Ladder logic programs must have immediate access to the sub elements of control structures (timers, counters, sequencers, etc.) by word (presets, accumulators, etc.) and bit (status bits).

2.06 Inputs/Outputs

2.06A Inputs/Outputs – General

A. A minimum of four isolated digital input groups, one isolated analog input group, six isolated digital output groups and one isolated analog output group shall be located on the self-contained controller. At least four relays shall be individually isolated.

B. The system must support at least 112 discrete I/O points using expansion I/O modules.

C. Isolation shall be between all internal logic and external circuits.

D. Each input and output point shall have a visual indicator to display ON/OFF status.

E. All user wiring to I/O modules shall be through a heavy-duty terminal strip. Pressure-type screw terminals shall be used to provide fast, secure wire connections.

F. Inputs shall have adjustable filter time constants to improve input performance in high speed applications, and to limit the effects of voltage transients.

G. The system must support seven expansion modules (input/output, discrete or analog).

2.06B Inputs/Outputs - Specific

A. The controller manufacturer shall offer input/output hardware consisting of the following types:

1. Standard Inputs

    a. Inputs: 120V AC, 240V AC, 24V DC sink, 24V DC source, 4-20 mA Analog , 0-10V Analog, RTD and Thermocouple

2. High Speed Counter (HSC)

    a. Each controller with 24V DC inputs must have at least three HSCs capable of detecting a 100 kHz pulse stream built onboard.

    b. Each HSC must be capable of detecting pulses as narrow as 5 microseconds (100 kHz) and directly control (turn on or off) controller outputs independent of the processor scan.

    c. Each HSC must be cable of detecting single ended inputs, quadrature inputs, and high speed inputs with external controls (hold and reset).

    d. Each HSC must be completely configurable (input filters, modes of operation, etc.) using computer based software. Runtime control of the HSC must be allowed through commands (instructions) in the user (ladder) program (Reset accumulator, change presets, change output patterns and setpoints, enable/disable HSC operation, etc.).

    e. Data and status within each HSC must also be accessible from external devices through the controller's communication ports.

3. High Speed Inputs

    a. Each controller with 24V DC inputs must have at least 12 inputs that can catch and hold for one inputs scan a 5 microsecond input signal.

    b. Each controller with 24V DC inputs must have four high speed inputs capable of generating an input interrupt. When used for input interrupt functionality, the controller must be capable of executing a predefined range of logic. Each input must be configurable to run its own user defined block of logic.

4. Standard Outputs

    a. Outputs: Relay (some of which must have individual isolation), 24V DC source, 4-20 mA Analog, 0-10V Analog and Triac.

    b. Relay outputs for DC devices which operate at 5-125V DC, with 2 amp continuous current capacity at 24V DC and 1 amp continuous current capacity 125V DC.

    c. Relay outputs for AC devices which operate at 5-264V AC with 5 amp continuous current capacity for UL508 up to 40° C (3A above 40° C) and 3 amp continuous current capacity for UL1604, Class 1, Division 2, Hazardous Locations, Groups A, B, C, and D.

5. High Speed Output

    a. Each controller with 24V DC outputs must have at least three high speed outputs. The outputs must be capable of generating PTO (pulse train output) signals. The PTO signals must be capable of generating motion profiles using either trapezoid or S-curve acceleration and deceleration profiles.

    The outputs must also be configurable for PWM (pulse width modulated) signals. When configured for PWM the controller must provide trapezoid acceleration/deceleration of either the frequency or duration portions of the PWM waveform.

2.07 Networking and Communications

A. The controller shall support direct connection to a programming computer equipped with a standard RS-232 serial port.

B. The controller shall support direct connection to a programming computer equipped with a standard RS-485 port.

C. The controller shall support direct connection to a programming computer equipped with a standard 10/100Mbps EtherNet/IP port.

D. The controller shall support direct connection to a modem for remote programming functionality.

E. The packaged controller shall support full function peer-to-peer communications (program management, controller-to-controller messaging, etc.):

- When directly connected by an RS-232 cable, RS-485 cable or Ethernet cable
- A “local” (hard wired) peer-to-peer network that supports up to 32 devices

F. The controller shall directly support EtherNet/IP peer-to-peer messaging.

G. The controller family shall support connectivity with DeviceNet. The controller must provide DeviceNet slave I/O functionality to a DeviceNet master, peer to peer messaging over DeviceNet, explicit messaging support over DeviceNet.

H. The controller shall support half-duplex slave communications on a network capable of at least of 250 nodes. The half-duplex network shall support program upload/download, monitoring, and peer-to-peer (slave to slave) communications.

I. The controller shall support connectivity to up to 31 other devices across a DH-485 network.

J. The controller shall support the DF1 Radio Modem protocol.

K. The controller shall support Modbus RTU master and slave communications.

L. The controller shall support bi-directional ASCII communications to send initialization strings to a modem, text with embedded data to a printer or terminal, receive ASCII from smart scales, bar code devices, etc.

M. The controller shall provide the ability to change the RS-232 communications port between the out-of-box factory default settings, and the user configuration settings. This operation must be allowed to occur at any time.

N. The controller must support baud rates from 300 to 38.4K baud.

O. The controller shall support Modbus/TCP over Ethernet

P. The controller shall support DNP3 serially and over Ethernet

Part 3 - Execution

3.01 Interfacing and Peripherals

A. The programming means shall be a Microsoft Windows based desktop/portable.

B. Programming software must run on Windows 98/ME/NT/2000/2003 Server/XP or Vista environments.

C. The programming software and the controller shall support online editing.

D. The programming terminal shall be compatible for interfacing with an electrical service of either 120V AC, 50/60 Hz or 220V AC, 50/60 Hz.

E. The terminal shall provide for selecting the communication rate between 110 and 38400 baud for RS-232-C communications.

F. The programming terminal shall be capable of displaying a rung consisting of a maximum of seven series elements and six parallel elements.

G. The means to indicate contact or output status shall be by intensification or color change of the contact or output on the CRT screen. Each element’s status shall be shown independently regardless of circuit configuration.

H. The controller system shall be able to interface with a data terminal which is RS-232-C compatible (up to 38400 baud) to generate hard copy logic diagrams and/or message generation.

I. The system shall have the capability to interface to a CD, DVD and/or a hard disk for loading a user program into, or recording the contents of, the processor's memory. It shall be possible to load or record the entire contents or selected portions of memory.

J. The controller must also have a small easy to use operator interface (OI) specifically designed to enhance operator interaction with the control system. The OI device should be panel mountable. Features required are menuing capabilities, security features, active display of data, limit test of entered data, and scaling of data to and from the controller. The system should make use of intuitive on screen programming features. All OI programs must be capable of being saved to disk and transported to other OI devices or programming computers. OI programs should be transferred via a RS-232 serial communications link between the computer and the OI device.

3.02 Programming Techniques

A. The programming format shall be relay ladder diagram.

B. It shall be possible to program a maximum instruction matrix containing as many as 128 instructions.

C. The capability shall exist to change a contact from normally open to normally closed, add instructions, change addresses, etc. It shall not be necessary to delete and reprogram the entire rung.

D. It shall be possible to insert relay ladder diagram rungs anywhere in the program, even between existing rungs, provided there is sufficient memory to accommodate these additions.

E. It shall be necessary to issue a two part command in order to delete all relay ladder rungs from memory. This will provide a safeguard wherein the operator must verify their intentions before erasing the entire program.

F. Latch functions shall be internal and programmable.

G. The system shall have the capability to address up to 10K words of data.

H. The system must support up to 255 data files. Each data file must be configurable from 1 to 255 data elements, and type (timers, counters, integer [16- or 32-bit], string, message or PID) plus any number of timers, counters, and internal bits up to a maximum of 10K words of data.

I. All management of instructions and data in memory shall be handled by the CPU. Instructions shall permit programming timers in the “ON” or “OFF” delay modes. Timer programming shall also include the capability to interrupt timing without resetting the timers. Counters shall be programmable using up-increment, down-increment or both. All timer and counter data must be accessible from the ladder program and also any communications device.

J. Timer instructions shall include selectable time bases in increments of 1.0, 0.01, and 0.001 second. The timing range of each timer shall be from 0 to 32,767 increments. It shall be possible to program and display separately the timer's preset and accumulated values.

K. The controller shall use a signed integer data format. The signed integer format (-32,768 to 32,767) must be used throughout the controller (counters, storage registers, math operations, etc.).

L. The controller shall support signed integer math functions consisting of addition, subtraction, multiplication, division, scale with parameters, and square root.

M. Instructions shall be provided for file manipulation instructions such as “file fill”, “first in-first out”, “last in-first out” shall be supported by the system. Four function math instructions and instructions for performing “logical OR”, “logical AND”, “exclusive OR”, and comparison instructions such as “less than”, “greater than”, and “equal to” shall be included within the system. All instructions shall execute on either single words, double words or files.

N. The system shall contain instructions for reading, writing, and manipulation of ASCII data. Instructions such as string extraction, concatenation, and byte swapping of data.

O. The system shall contain instructions which will construct synchronous 16-bit word shift registers. Additional instructions shall be provided to construct synchronous bit shift registers.

P. The controller shall have a jump instruction which will allow the programmer to jump over portions of the user program to a portion marked by a matching label instruction.

Q. The controller shall have an instruction which will allow the programmer to display a combination of bits, integers and strings to the embedded HMI and optionally to receive bits, integers, or long integers from the HMI.

R. In applications requiring repeatable logic rungs it shall be possible to place such rungs in a subroutine section. Instructions which call the subroutine and return to the main program shall be included within the system. It shall be possible to program several subroutines and define each subroutine by a unique label. The processor will support nesting of subroutines. The program format as displayed on the CRT shall clearly define the main program and all subroutines.

S. The program format shall display all instructions on a CRT programming panel with appropriate mnemonics to define all data entered by the programmer. The system shall be capable of providing a “HELP” instruction which when called by the programmer will display on the CRT a list of instructions and all data required to enter an instruction into the system memory.

T. At the request of the programmer, data contained in system memory shall be displayed on the CRT programming panel. This monitoring feature shall be provided for input/output status, timer/counter data, files, and system status. Ladder logic rungs shall be displayed on the CRT with rung numbers in sequential order.

U. The system shall have the capability to enter rung comments above ladder logic rungs. These comments may be entered at the same time the ladder logic is entered.

V. It shall be possible to manually set (force) either on or off all hardwired input or output points. Removal of these forced I/O points shall be either individually or totally through selected keystrokes. The programming terminal shall be able to display forced I/O points.

W. The execution of the program logic shall be accelerated by scanning the rung only until a positive decision as to the state of the outputs has been made. In many cases, this will mean skipping over logic elements if the output condition has been predetermined.

X. A means to program a fault recovery routine shall exist. When a major system fault occurs in the system, the fault recovery routine shall be executed and then the system shall determine if the fault has been eliminated. If the fault is eliminated, program execution resumes. If the fault still exists, the system will shut down.

Y. An interrupt routine shall be programmable such that the routine shall be executed regularly. The interval at which the routine is executed shall be user-specified in the range of 1 to 32767 milliseconds in 1 msec increments. This routine must be able to close an asynchronous control loop consisting of 32 Input points, 32 output points, 100 contact/coils, 10 addition instructions, 10 subtraction instructions and 32 circular comparison (Limit) instructions while never exceeding a 3 millisecond interval. The measurement of this interval is from after the Input filter delay time to the time that the physical outputs start to transition.

Z. The ability to program ladder logic via symbols from the global database of the packaged controller shall exist.

AA. The CPU shall support indirect addressing of inputs and outputs, along with all data table words (integer, binary, timers, and counters) for the software instruction set.

BB. The system shall support both bit and word level diagnostic instructions.

CC. To facilitate conditional event detection programming, output instructions shall include a “one shot” instruction which may be triggered on the low-to-high (rising) rung condition.

DD. The processor shall support Master Control Reset (Relay) type functionality to selectively disable sections of relay ladder logic.

3.03 Quality Requirements

A. The controller shall be able to withstand conducted susceptibility tests as outlined in:

- ESD Immunity — EN 61000-4-2
  4 kV contact, 8 kV air and 4 kV indirect
- Radiated Immunity — ENV 50204
  10V/m, 1000 MHz
- Radiated RF Immunity — EN 61000-4-3
  10V/m, 26-1000 MHz (alternatively 80-1000 MHz), 80% amplitude modulation, 900 MHz keyed carrier
- Fast Transient Immunity — EN 61000-4-4
  Power Supply, I/O: 2 kV, 5 kHz
  Communications Cable: 1 kV, 5 kHz
- Surge Transient Immunity — EN 61000-4-5
  Unshielded Communications Cable: 2 kV CM (common mode), 1 kV DM (differential mode)
  Shielded Communications Cable: 1 kV galvanic gun
  I/O: 2 kV CM (common mode), 1 kV DM (differential mode)
  AC Power Supply Input: 4 kV CM (common Mode), 2 kV DM (differential mode)
  DC Power Supply Input: 500V CM (common mode), 500V DM (differential mode)
  AC/DC Auxiliary Output: 500V CM (common mode), 500V DM (differential mode)
- Conducted RF Immunity — EN 61000-4-6
  10V, 150 kHz to 80 MHz
- Conducted Emissions — EN 55011
  AC Power Supply Input: 150 kHz to 30 MHz
- Radiated Emissions — EN 55011
  30-1000 MHz
- Line Related Tests — EN 61000-4-11
  AC Power Supply Input:
  Voltage drop: -30% for 10 ms, -60% for 100 ms
  Voltage interrupt: At voltage greater than -95% for 5 sec.
  Voltage fluctuation: 10% for 15 minutes, -10% for 15 minutes
  DC Power Supply Input:
  Voltage fluctuation: 20% for 15 minutes, -20% for 15 minutes

B. The controller and its associated peripherals shall be listed or recognized by the following registrations: UL listed; CSA or CUL certified; CE certified; and suitable for operation in Class I, Division 2, Groups A, B, C, and D hazardous locations.