Building Automation System Specification

Clause 1 - DDC SYSTEM REQUIREMENTS

1.1 General

The DDC system will consist of a combination of Building Controllers and Custom Application Controllers linked together on a main Local Area Network (LAN) and subLAN, measuring and controlling input and output devices and being accessed and programmed from one or more Operator Workstations (OWS).

1.2 Monitoring and Control Features

.1 Operator defined digital and analogue alarms and automatic alarm condition reporting.

.2 Direct keyboard override of all inputs and outputs, with an indication on the display for any point that is operating under keyboard override.

.3 Addition, deletion, definition and modification of all points from operator keyboard.

.4 Trend log graphing and reporting of user selected points at user defined intervals.

.5 Run time logging of digital points.

.6 Ability to accept a variety of standard analogue and digital input signals.

.7 Ability to generate a variety of standard analogue and digital output signals.

1.3 Off-Line Storage

.1 The DDC system shall have the capability to be taken off-line in the event of failure or for maintenance and returned to operation without the need for entering any portion of the software program manually.

.2 An off-line disk storage device shall be utilized to provide software backup and reload. Backup and verification of the entire system, with full applications software, shall be less than TWO (2) seconds per real point.

1.4 Power Surge Protection

.1 The DDC system shall be protected form power line surges and voltage transients.

1.5 Power Failure Protection

.1 The DDC system shall have automatic protection from any power failure of at least TWENTY-FOUR (24) hours duration.

.2 This protection shall at a minimum include continuous real-time clock operation and automatic system restart upon power return.

.3 Outputs shall have the option of being set to “staggered start” upon power reset.
1.6 Operator Control Language

The Operator Control Language (OCL) will support the concept of output oriented code allowing many small individual programs to be written and connected to graphic screens. Each output and/or calculation will have its own dedicated program and not be part of one larger program.

.1 The DDC system shall have the capacity for timed start/stop on daily schedules, as well as the capability for the owner to develop and run user written application programs. For this, the DDC system shall have a proven OCL which shall be capable of reading the value and/or status of all system points and initiating both analogue and digital control actions from any user defined combination of calculations and logical expressions which shall at a minimum include:

- Addition, subtraction, multiplication and division.
- Square roots, summations, absolute differences.
- IF THEN ELSE statements.
- Logical “not”, “and”, “or”, “less than”, “greater than”, and “equal to” or their equivalents.
- Time delays in seconds, minutes or hours.
- Ability to imbed comments in system generated documentation.
- Ability to use time-of-day and day-of year in algebraic calculations.
- Ability to filter continuous small changes in input signals to prevent equally small increment in output signals from occurring.

All of the above functions must be accomplished via software. FIRMWARE BASED FUNCTIONS WILL NOT BE ACCEPTED.

1.7 Editing Features

.1 Provide full screen editor to enable editing of the OCL programs source code down to character by character changes.

.2 Provide the capability in the editor of accepting programs from ASCII files that have been created on other text editors and word processors.

.3 If a point name is changed, all occurrences of that will point will automatically be changed, regardless of where the occurrence exists.

.4 Provide cutting and pasting functions within editor, such that sections of OCL code from one program can be easily cut and pasted into a different OCL code on residing in another controller.

.5 Provide debug utility which will indicate line of OCL containing structural or syntax error.

.6 If OCL contains line number, provide automatic renumbering feature to sequentially renumber lines.

.7 Provide the capability to automatically view value and/or status of points used within OCL code without exiting editor.

.8 Provide at least TEN (10) unique local variables that can be declared for each individual OCL code.
1.8 Inter-Controller Communications

.1 Provide a fully networked system of controllers which use LAN communications to support the distributed control features as specified herein. Each controller shall be connected directly to the LAN. Each controller shall have equal LAN access priority and shall NOT REQUIRE A SEPARATE GATEWAY or interface controller to accomplish normal, network communications.

.2 Provide a means to ensure communication integrity. At a minimum indicate for each controller in system: on-line/off-line status, residence of program or no program, the scan rate (frequency at which the controller updates all I/O and runs all programs), the number of network points imported and exported.

.3 The system will display an error message, in the event of a communication error.

.4 To prevent damage to the system, each connection to the LAN shall be provided with a means of isolation, either optically or fast-blow fuse or by some other means.

.5 Upon failure of the LAN to communicate information, each controller will retain the last legitimate value of its imported network points, and continue to control the systems based on those values. Failure of any controller, or any part of a controller on the LAN, shall not affect the ability of the LAN to communicate among the remaining controllers.

.6 Each hard point and soft point shall have a user-definable, unique, system-wide logical point mnemonic. The format of the point mnemonic shall conform to the BCBC Client Comfort Guidelines naming convention. (See www.bcbc.ca/internet/ccs/index.html)

1.9 Memory

.1 Each controller shall have enough random access memory for all of the following:

.1 Variables - ONE (1) for each hard point connected to the controller.

.2 PID Controllers - TWO (2) for each analogue output point connected to the controller.

.3 Weekly Schedules - ONE (1) for every major system connected to the controller.

.4 Annual Schedule - ONE (1) for the entire LAN.

.5 Trend Logs - ONE (1) for each pair of hard points connected to the controller with 100 samples each.

.6 Runtime Logs - ONE (1) for each digital hard and soft point.

.7 Programs - ONE (1) for each output point connected to the controller. Each program must contain enough memory for TWENTY (20) syntactically correct lines of OCL with at least four operators.

1.10 Processing Speed
.1 Scan Rate - The maximum permissible scan rate is ONE (1) second. The scan rate is defined as the time it takes to controller CPU to sample all inputs, calculate all variables, update all timers and PID controllers, check all schedules, update all trend logs and runtime logs execute all OCL programs and assign values to all outputs.
Clause 2 – CONTROLLER HARDWARE AND SOFTWARE

2.1 Building Controllers

.1 Building Controllers shall reside on the main LAN or highest level of communication.

.2 The controller shall communicate on the main LAN using either Ethernet (IEEE.802.3) with TCP/IP and/or EIA-485.

.2 In addition to main LAN communications, the controller shall support two EIA-485 subLANs, PC, modem and intelligent thermostat communications.

.3 The controller shall have at least one port (other than the PC port) which can be configured to BACnet conformance class 3 using EIA-232 point-to-point communications for interface to other BACnet products.

.4 The controller must be modular in design with removable I/O device terminations on separate I/O cards for ease of expansion and replacement.

.5 The controller will accommodate a maximum of 128 universal I/O points on board using a single address.

.6 All I/O points must be universal (i.e. user definable as digital or analogue). Dedicated analogue/digital points will not be accepted.

.7 All outputs must have HOA on board for easy override by non DDC users.

2.2 Custom Application Controllers

.1 Custom Application Controllers shall communicate on the main LAN or subLAN using EIA-485.

.2 In addition to main or subLAN communications, the controller shall support PC and/or modem communications and intelligent thermostat communications.

.2 Programming the controller shall be accomplished over the LAN or directly via PC or modem and will not require the mandatory use of any other special interface hardware or a Building Controller.

.3 The controller must be modular in design with removable I/O device terminations for ease of replacement.

.5 The controller will accommodate a minimum of 16 universal I/O points and a maximum of 64 universal I/O points on board using a single address.

.6 All I/O points must be universal (i.e. user definable as digital or analogue). Dedicated analogue/digital points will not be accepted.

2.3 Operator Interface
.1 General

The operator interface shall operate on any IBM compatible PC running Windows'95, 98, 2000 or NT. The software shall communicate with the DDC system as follows:

.1 via Ethernet
.2 via PC direct connection
.3 via modem

Access to the system shall be available by all three methods simultaneously.

.2 Access Security

The system shall have a minimum of 128 passwords and six levels of security.

.3 Off Line Programming

The software shall have a “simulator” facility that allows controllers to be fully programmed off line without the need of any controller hardware.

.4 Database Programming

The software shall allow the operator to easily program and modify the complete database of any controller.

.5 OCL Programming

The software shall allow the operator to easily program and modify the control strategy language for any controller.

.6 Graphic Programming

The software shall allow the operator to easily utilize colour graphics in generating user defined, dynamic data displays or system groups. The graphic images are created in any third party application (e.g. CorelDraw, Macromedia Fireworks, Adobe Illustrator, VisioTechnical, etc) and exported as a bit mapped image (.bmp,.tif) for use within the DDC system. The operator shall be able to annotate the graphic with any combination of hard points, soft points, and keywords, and have the ability to link any group to any other group from any controller in the system. The operator will have the ability to display either the description, value or status of a point, using any colour. Any point shall have the ability to be hidden from view, yet retain functionality if accessed. The graphics must support mouse and keyboard cursor access. Each system group graphic will accommodate 160 annotations.
Clause 3 - INSTALLATION

2.1 Enclosures and Conduit

.1 All controllers shall be installed neatly in an appropriately sized enclosure as per the manufacturer’s specifications.

.2 Relays, transformers, and I/O devices and peripherals shall be installed in separate enclosures and not in the enclosures containing the controllers.

.3 All wires penetrating the enclosure that are not required to be in conduit must be neatly bundled and strapped in place.

.4 All Building Controllers will be installed in enclosures that are complete with hinged and key-locked doors. The door will be painted and labeled suitably bearing the manufacturer’s system name/logos, the controller address, and the installing contractor’s contact information. This enclosure will be mounted at a height that provides easy access without the need of a ladder.

.5 Custom Application Controllers may reside above T-bar ceiling spaces in conventional screw lid enclosures.

.6 All enclosures will be CSA rated.

.7 A hard points list shall be affixed on the inside surface of the door/cover of the enclosure.

.8 The inside bottom surface of the enclosure shall be clean of dirt, metal shavings, and debris.

.9 All conduit will be piped smoothly and neatly following building lines.

.10 All junction boxes will have covers properly and firmly affixed after installation completion.

2.2 I/O Wiring

.1 All input/output device wiring will use #18-2 solid core cable with individually jacked conductors and jacketed sheath over the pair.

.2 Use plenum cable where required.

.3 All I/O wiring passing near or within the enclosure of a VFD will be shielded, with the shield terminated at the device end.

.5 All I/O wiring will be suitably identified using Panduit adhesive wire-marker or equivalent at the controller end.

.6 All I/O wiring within controller enclosure shall be neat and tidy and suitably bundled and strapped or contained in Panduit wire duct or equivalent.

.7 All I/O wiring that requires a transition to a different conductor to meet electrical code requirement shall be executed using a terminal strip. MARRET CONNECTIONS ARE
Building Automation System Specification

NOT ACCEPTABLE FOR ANY CONNECTION other than to connect low-voltage pigtails at the device end (e.g. thermistors, 24VAC/VDC transducers, actuators etc.).

.8 Low voltage I/O wiring may be mixed together within a conduit.

2.3 Power Wiring

.1 Provide power wiring and transformers and grounding to each controller and transducer as per the manufacturer’s specification.

.2 Each Building Controller will have it’s own dedicated power supply. No other controller or I/O device will be powered from this supply.

.3 Custom Application Controllers may share a common power supply, but this supply will not be used for any other device (e.g. I/O devices).

.4 Power wiring shall not be mixed with I/O wiring in a conduit.

2.4 LAN Wiring

.1 Provide LAN wiring as per the manufacturer’s specification.

.2 For EIA-485 LAN wiring, use either shielded or “balanced (unshielded)” #18-2 or #20-2 cable. If shielded cable is used, ensure that each contiguous section of shield is terminated at a single point.

This specification incorporates many of the design concepts and requirements outlined in the ASHRAE guideline GPC-13P, and the BCBC Client Comfort Guidelines. The author of this specification acknowledges the beneficial contribution of both of these technical bodies. Please see origin sources at www.ashrae.org and www.bcbc.bc.ca.