



BASpi – 12-point BACnet/IP Sedona Expansion Board

The BASpi I/O board is a 12-point BAS expansion board for Raspberry Pi. The I/O board, plus the firmware files provided by Contemporary Controls turn your Raspberry Pi into a BACnet-networked, Sedona-programmable controller with 6 Universal Inputs and 6 Relay Outputs. All 12 physical I/O points, in addition to 24 Virtual Points are served up over BACnet/IP using Ethernet or Wi-Fi. BASpi is web page configurable over Ethernet or Wi-Fi

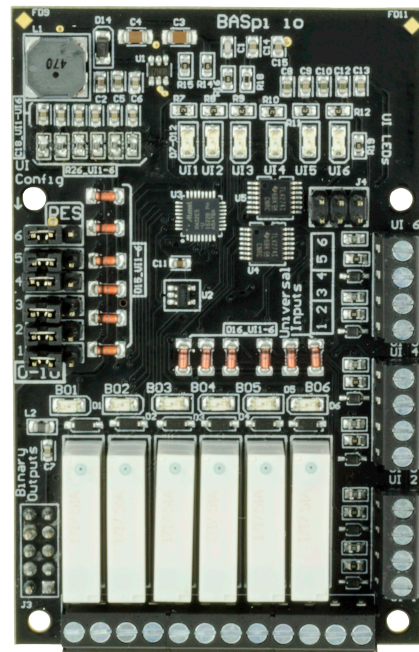
connections. The Sedona Application Editor (SAE) is offered as part of the free BAScontrol Toolset. This programming tool is used to create control applications by linking graphical components on a wiresheet. In addition to SAE, BASemulator gives you BASpi software emulation for PC and BASbackup allows you to backup and restore your entire BASpi project to a zip file.

Versatile Control Device

- BACnet/IP Server - 12 physical points and 24 virtual points
- BACnet/IP over Ethernet or Wi-Fi
- Resident Sedona Virtual Machine (SVM)
- Graphically programmable with free Sedona Application Editor
- Email alarms/notifications triggered by Sedona logic
- Weekly schedule with exceptions/holidays
- Free project backup and restore utility - BASbackup and free software emulator for PC - BASemulator
- Web page configurable with a common web browser over Ethernet or Wi-Fi (2.4GHz 802.11b/g/n)
- NTP server or manually-settable clock

Flexible Input/Output — 12-points of physical I/O

- Six configurable Universal Inputs: Analog Input (0-10V), Binary Input, Resistance, Thermistor (10KT2, 10KT3, 20K), Pulse Input max (40Hz)
- Six Relay Outputs (2A max current)
- 24 Virtual Points used to read or write data to/from wiresheet by a BACnet client/supervisor station
- 48 Web Components allow live monitoring and forcing of wiresheet points from the BASpi's web page



Sedona

BASpi I/O board is compatible with Raspberry Pi 3 or 4 and requires a Raspbian with Desktop installation, as well as firmware files provided by Contemporary Controls. The firmware will only run if the BASpi-IO board hardware is installed on the Raspberry Pi. There are two installation options for the BASpi I/O board firmware:

- The entire Raspbian image (Raspbian with Desktop + BASpi firmware files) provided by Contemporary Controls as a download. All you would need to do is download it from www.baspi.io, write it to an 8GB or larger SD card, and power it up.

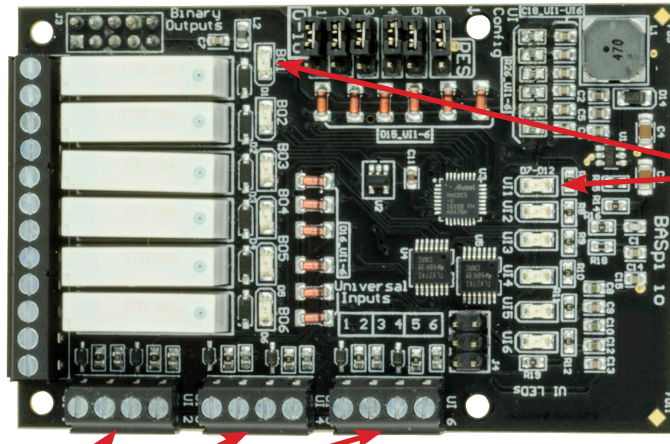
- The BASpi stand-alone firmware files can be downloaded and copied to a USB drive, transferred, and installed onto your existing Raspbian system.

BASpi-IO is supported by the free BAScontrol Toolset including Sedona Application Editor used to create graphical wire sheet programs for sequence of operation, BASbackup project archiving and restore utility, and BASemulator which provides BASpi emulation on your PC. All BASpi downloads can be freely accessed at www.baspi.io

BASpi – Overview

The BASpi IO board utilizes the powerful 64-bit CPU in the Raspberry Pi as well as its Ethernet and Wi-Fi adapters for network connectivity. The board is powered through the 10-pin header which mates with the Raspberry Pi GPIO Header pins 1 through 10. By operating at the BACnet/IP level, the BASpi can share the same Ethernet or Wi-Fi network with BACnet supervisory controllers and operator workstations. The BASpi's Sedona Virtual Machine can be accessed over wired Ethernet IP connection, or wirelessly over Wi-Fi. The BACnet server can be operational on one physical layer at a time only, either wired over Ethernet, or wireless over Wi-Fi. You can select which layer you want BACnet /IP to be served on from System Configuration page (WIRED or WIRELESS). The unit can be configured for a fixed IP address or can operate as a DHCP client receiving its IP address from a DHCP server. An NTP or manually-

configurable clock allows for creating a local schedule. The weekly schedule is web page configurable and allows for entry of special event/holiday schedule exceptions. A schedule Sedona component is used to trigger logic. The BASpi can send email alarms/ notifications. Email alarms are web page configurable and allow for multiple point or wire sheet values to be included in the sent email. Emails can be sent to multiple recipients. An email Sedona component is used to trigger the alarms/notifications. Universal input channels are set for 0-10V input by default. Channel configuration is accomplished using the web page and setting the channel type using a 3-pin jumper. Type II and type III 10 k Ω thermistor curves and a 20 k Ω thermistor curve are resident in the unit. Pulse inputs with or without pull up are supported at up to 40Hz. Contact closure inputs require a voltage-free source.



Binary Outputs
Six form "A" relays for 30 VAC/VDC 2 A loads. Class 2 circuits only.

Point LEDs
for all 12 points

Universal Inputs

Six input channels can be configured — all discoverable as BACnet objects.

- Analog inputs: 0–10 VDC, (+/- 1% precision)
- Temperature inputs: Type II or Type III 10 kΩ thermistors; 20 kΩ thermistor
- Resistance inputs range of: 1 kΩ to 100 kΩ
- Pulse input: accommodates active or passive sources (40 Hz max)
- Binary Input: voltage-free contact closure

BASpi Software Tools

The BAScontrol Toolset is offered as a free download. A link to obtain the free toolset is available at www.baspi.io. Refer to the Quick Start Guide for more information on getting started with the toolset. For complete details on Sedona operation and components see the Sedona Open Control Reference Manual at:

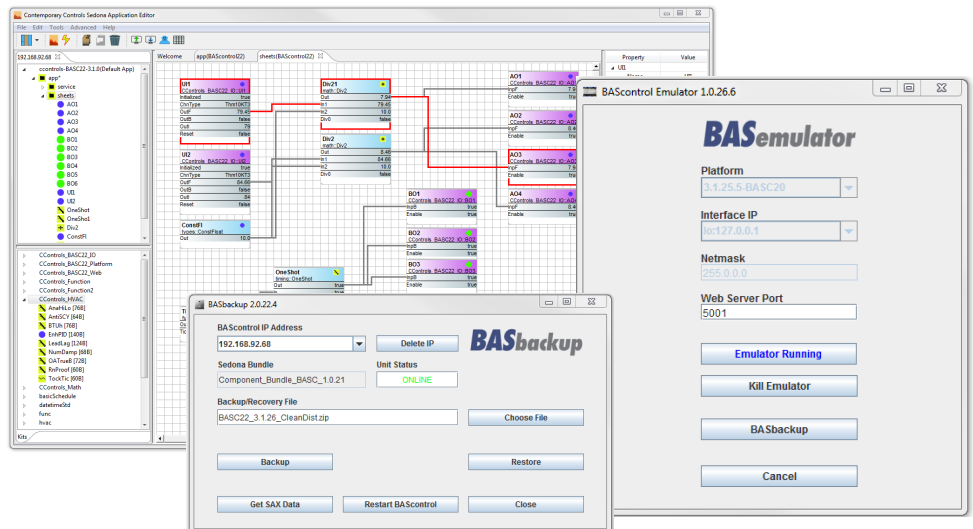
<https://www.ccontrols.com/tech/sedona.htm>

The BAScontrol Toolset consists of:

BASbackup – allows you to backup and restore Sedona wiresheet applications and/or complete device configuration between real controllers or emulated controllers (using BASemulator). In addition, it allows you to create a transferrable backup file which can be used to clone controllers or reproduce controllers with slightly altered settings.

Sedona Application Editor (SAE) – used to connect to Sedona devices, write/edit graphical Sedona wiresheet control applications and saving local wiresheet application (SAX file) copies to a Windows PC/laptop.

BASemulator – is a software emulator for the BAScontrol series which runs on Windows. This controller emulator allows you to write your Sedona wiresheet application and fully configure all parameters such as I/O Channel configuration, BACnet settings, and Network settings before deploying onto real controllers.



Configuring the Universal Inputs

The BASpi is web page configurable over wired Ethernet IP connection, or wirelessly over Wi-Fi. The web page allows for easy configuration, live monitoring, and forcing of physical points, virtual points, and web components. All points are accessible from the BASpi web page, BACnet /IP clients, and the Sedona wiresheet.

The BASpi universal inputs can be configured for several different channel types. There are two circuits on the six Universal Inputs which are jumper-selectable (UI config diagram). **RES** circuit utilizes a pull-up and the **0-10** does not. Depending on your input type, select pull up or no pull up for each channel by moving the jumpers accordingly.

First configure the jumper on the board:

1. For resistance or thermistor inputs and binary or pulse inputs which require a pull up, set the config jumper to "RES"

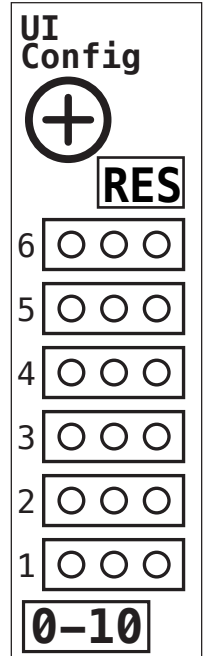
After configuring the jumper, select an appropriate channel type from the web page:

- Therm 10KT2
- Therm 10KT3
- Therm 20K
- Resistance
- Binary Input
- Pulse Input

2. For analog, pulse, and binary input (which do not require pull up), set the config jumper to "0-10"

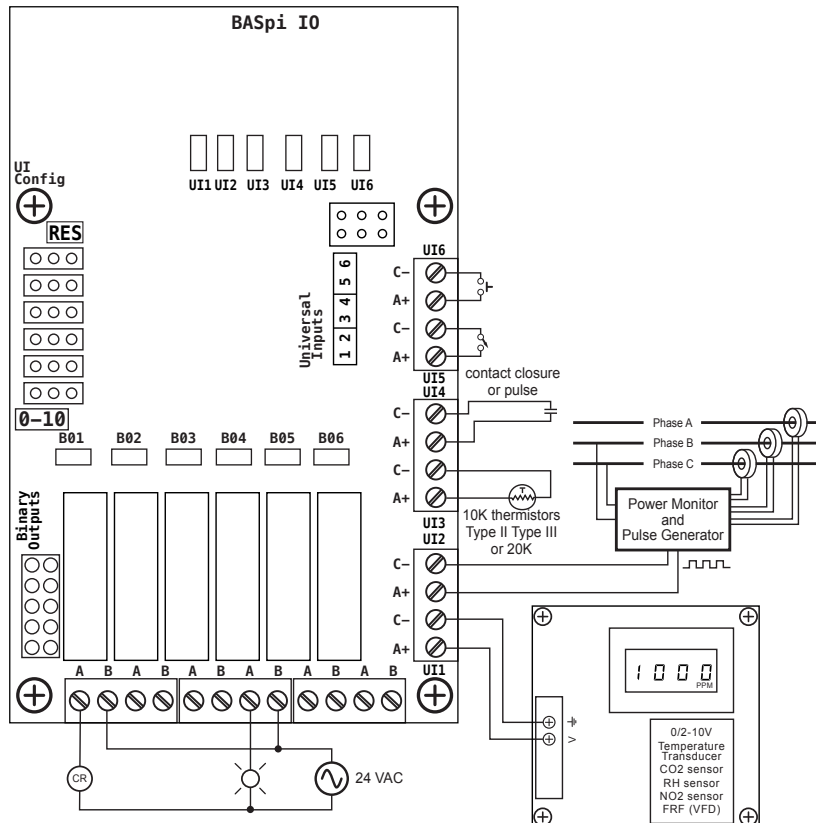
After configuring the jumper, select an appropriate channel type from the web page:

- Analog Input
- Binary Input
- Pulse Input



(see next section - Web page configuration for more web page detail).

BASpi Wiring Diagram



Web Page Configuration – Main Page and System Configuration

The BASpi is web page configurable over wired 10/100Mbps IP Ethernet connection, or wirelessly over Wi-Fi (2.4GHz 802.11b/g/n). The web page allows for easy system and channel configuration, live monitoring, and forcing of physical points, virtual points, and web components. Initially, the BASpi can be accessed over Ethernet cable at its default IP address of 192.168.92.68 with a sub-net mask of 255.255.255.0 or it can be accessed internally

(from the Raspberry Pi web browser itself) at its local host address of 127.0.0.1.

The web page requires login authentication:

user name: admin
password: admin

The screenshot displays the BASpi 6U/6R web interface. It is divided into two main sections: **Universal Inputs** and **Binary Outputs**.

Universal Inputs:

- UI1: Voltage Input 1 (10.000) - Green label 'a' is next to the value.
- UI2: Voltage Input 2 (10.005)
- UI3: Zone Setpoint (RES) (10394.000)
- UI4: Zone Temperature (75.230°F)
- UI5: Universal Input 5 (0.015)
- UI6: Temp Occupancy Switch (0)

Binary Outputs:

- BO1: Cool Stage 1 (0)
- BO2: Cool Stage 2 (0) - Green label 'c' is next to the value.
- BO3: Heat Stage 1 (1)
- BO4: Heat Stage 2 (0)
- BO5: Binary Output 5 (0)
- BO6: Fan (1)

At the bottom of the interface, there is a navigation bar with buttons: System Config, System Status, Set Time, Virtual Points, Web Components, Schedule, Email, and Restart. Below the navigation bar is a status bar with a toggle switch for 'Auto Refresh OFF' and a green label 'b' next to it. At the very bottom, there is copyright information: Copyright 2019 Contemporary Control Systems, Inc. All rights reserved. Firmware Revision 1.0.29.41 : Web Page Revision 7.0.2. A note states: NOTE: A GREEN label indicates that the I/O point has been placed on the wire sheet.

The main web page provides an overview of all real points plus access to other web pages. To configure a point, click on the point name (a) and a configuration page will appear. To observe the updated data for each point, click Auto Refresh button to ON (b). Point values can be temporarily forced by checking the box adjacent to the point

(c), entering a value into the point's text box and clicking outside the box. The value will remain forced until the box is unchecked or the unit power cycled. Care must be exercised when forcing values into points. The BASpi unit can be restarted using the Restart Controller button (d).

System Configuration page allows you to easily set up the Ethernet and Wi-Fi network adapters, BACnet server configuration, and credentials authorization. Changes to this page will not take effect until the device has been rebooted.

The BASpi can operate on both network adapters concurrently with the exception of the BACnet server which will only operate on the selected adapter. The IP settings can be changed to the desired values. Either DHCP or a static IP address can be selected. If a static address is desired, enter the value along with the network mask and gateway address. If domain address is required, enter in the Primary and Secondary DNS addresses.

BACnet device data must be entered when using BACnet. Make sure the Device Instance (0-65536) is unique over the complete BACnet Internetwork. Device Object Name is the name which BACnet clients will see when the BASpi is discovered and/or trended into the BACnet client database. The BACnet UDP port is set to 47808 as a decimal value, also equivalent to BAC0 in hexadecimal by default. This UDP port number is used by BACnet clients when doing a discovery of the BACnet network. This port number can be changed as long as it is the same in both the client and server BACnet devices. BBMD feature requires a BACnet router with BBMD capability.

Either BACnet or Sedona protocols or both can be selected. BACnet checkmark enables the BACnet /IP server and the Sedona checkmark enables the Sedona Virtual Machine. Once satisfied with System Configuration, click Submit, then Close, and Restart Controller for changes to be applied on next bootup of BASpi.

Admin	Wired	Wi-Fi	BACnet	Close	Submit
Enable Protocol					
BACnet/IP	<input checked="" type="checkbox"/>	Sedona	<input checked="" type="checkbox"/>		
Authentication					
User Name	<input type="text" value="admin"/>		Password	<input type="password" value="•••••"/>	

Admin	Wired	Wi-Fi	BACnet	Close	Submit
IP Configuration					
IP Mode	<input type="text" value="STATIC"/>				
Address	<input type="text" value="10.0.13.203"/>				
Netmask	<input type="text" value="255.255.240.0"/>				
Gateway	<input type="text" value="10.0.0.3"/>				
DNS Configuration					
DNS1	<input type="text" value="8.8.8.8"/>				
DNS2	<input type="text" value="8.8.4.4"/>				

Admin	Wired	Wi-Fi	BACnet	Close	Submit
Wi-Fi Configuration					
IP Mode	<input type="text" value="OFF"/>				
Address	<input type="text" value="192.168.2.157"/>				
Netmask	<input type="text" value="255.255.255.0"/>				
Gateway	<input type="text" value="192.168.2.1"/>				
SSID	<input type="text" value="ssid"/>				
Password	<input type="password" value="••••"/>				

Admin	Wired	Wi-Fi	BACnet	Close	Submit
BACnet Configuration					
Device Name	<input type="text" value="BASpi 6U/6R"/>				
Device Instance	<input type="text" value="213203"/>				
UDP Port	<input type="text" value="47808"/>				
BBMD IP Address	<input type="text" value="0.0.0.0"/>				
BBMD Reg Time	<input type="text" value="100"/>				
Interface	<input type="text" value="WIRED"/>				

Web Page Configuration – Channel, Time and Web Components

Channel Configuration

After you have configured the 3-position jumper on the BASpi board, you can select the channel type for each of the six channels from the web page. For resistance or thermistor inputs and binary or pulse inputs with pull up, set the config jumper to “RES”. After configuring the jumper, select an appropriate channel type from the web page:

- Therm 10KT2
- Therm 10KT3
- Therm 20K
- Resistance
- Binary Input
- Pulse Input

For analog, pulse, and binary input (without pull up), set the config jumper to “0-10”

After configuring the jumper, select an appropriate channel type from the web page:

- Analog Input
- Binary Input
- Pulse Input

BACnet channel configuration allows you to specify how the point is served to BACnet clients. Object Name is the name the channel will appear as when discovered by a BACnet client. Object Description allows you to give more information about the point. Units parameter allows you to specify the units for the channel value. COV Increment is the change-of-value increment used by BACnet clients which support this service. COV only reports changes in value instead of continuously serving the point. You do not need to set up COV unless the BACnet client you are using supports this service.

Some channel configuration options allow for additional settings.

- The Thermistor curves allow for positive or negative offset adjustment.
- Resistance channel types allow to specify an open circuit value.
- Pulse input channel types allow for Maximum Value of pulses counted (max setting by default), as well as High and Low thresholds for active inputs.

BACnet Object Configuration

UI6

Channel Type: Therm 10KT3

Temperature Offset: 0

Temperature Units: Fahrenheit Out of Bounds Value: 77

Object Instance: 6

Object Name: Zone Temperature

Object Type: Analog Input

Object Description: Zone Temperature

Units: VOLTS

COV Increment: 0

Close Submit

BACnet Object Configuration

UI1

Channel Type: Resistance

Open Circuit Value: 100000

BACnet Object Configuration

UI3

Channel Type: Pulse Input

Maximum Value: 16777215 High Threshold: 7.5

Pull Up Resistor: Enabled Low Threshold: 2.5

Time Configuration

Time and date can be set manually or automatically with the help of an NTP server if access to the Internet is possible over Ethernet or Wi-Fi. Daylight Savings Time can be enabled and configured accordingly. If accessing an NTP server using domain names, make sure the DNS servers are specified in the System Configuration screen.

Setting the correct geolocation allows the Sunrise Sedona component to calculate minutes to sunrise/sunset.

The screenshot shows a web interface for time configuration. It is divided into four main sections:

- System Time:** Includes fields for Year (2019), Month (October), Day (18), Hour (4 PM), and Minute (22). There are buttons for "Manual Time Set" and "Refresh ON".
- NTP Configuration:** Includes a checkbox for "NTP Enabled", an NTP Server field (pool.ntp.org), a Time Zone dropdown (Central:UTC-6), and a Refresh (Days) field (1).
- DST Configuration:** Includes a checkbox for "DST Enabled", and dropdowns for DST ON (March), DST OFF (November), Day of Month (2nd SUN), and Hour (2 AM).
- Sunrise/Sunset:** Includes Latitude (41.808919) and Longitude (-88.011175) fields, and calculated Sunrise (6:07 AM) and Sunset (5:06 PM) times.

Web Components Configuration

Web Components allow you to read/write Sedona logic data from the BASpi web page. These points are served up to the BASpi's web page. You can configure up to 48 web components. These components provide a means to write and read data to and from Sedona wire sheets without the need of a Sedona Editor tool. A web component configured as a wire sheet input can have its input range restricted to minimum and maximum values eliminating the need to add limit detection within the wire sheet logic. Web components are ideal for simplified control logic configuration. Web Components are not served up over BACnet.

The screenshot shows a table for configuring web components. The table has the following columns: Description, Value, Wire Sheet, Min, and Max. There are 8 rows of components, each with a "Default Web Component" description. A note at the bottom states: "NOTE: A GREEN label indicates that the component has been placed on the wire sheet." Buttons for "Auto Refresh ON", "Close", and "Submit" are also visible.

Description	Value	Wire Sheet	Min	Max
WC01 Switch Status	0.000000	Output		
WC02 Default Web Component 2	0.000000	Input	0.000000	100.000000
WC03 Default Web Component 3	0.000000	Input	0.000000	100.000000
WC04 Default Web Component 4	0.000000	Input	0.000000	100.000000
WC05 Default Web Component 5	0.000000	Input	0.000000	100.000000
WC06 Default Web Component 6	0.000000	Input	0.000000	100.000000
WC07 Default Web Component 7	0.000000	Input	0.000000	100.000000
WC08 Default Web Component 8	0.000000	Input	0.000000	100.000000

Virtual Points Configuration

Virtual Points allow you to read/write Sedona logic data from a BACnet client. These points are served up over BACnet. You may use a tool such as the free BDT (BACnet Discovery Tool) from Contemporary Controls to discover, read and write points on the BASpi. The Virtual points web page is accessible from the main page by clicking the "Virtual Points" button. Virtual Points can be configured and forced in the same manner as the physical IO channels. All 24 Virtual Points are served up over BACnet.

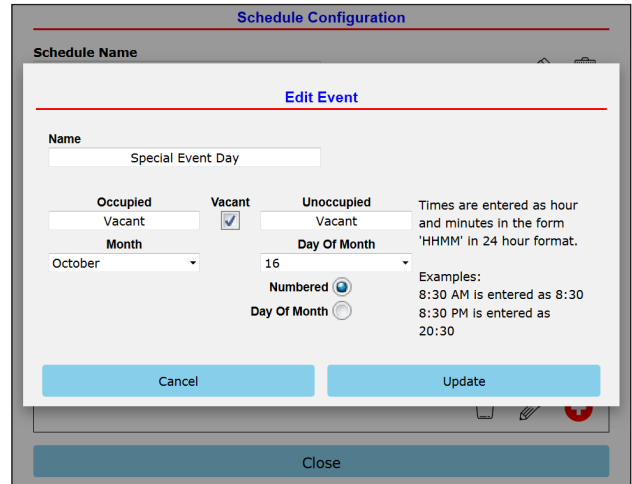
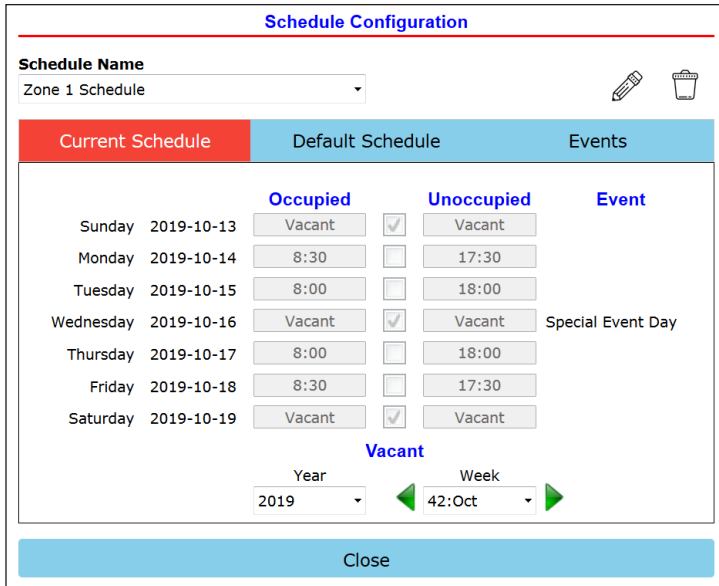
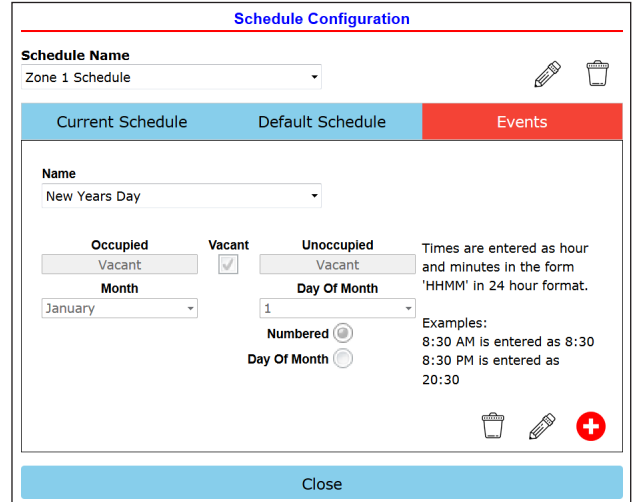
The screenshot shows a grid of 24 virtual points, labeled VT01 through VT24. Each point has a description, a current value, and a checkbox. The values are mostly 0.000, except for VT01 (Zone Temp) which is 85.270. A "Wiresheet BACnet Status" is shown as 0.000. An "Auto Refresh ON" button is at the bottom.

Virtual Point	Description	Value	Checkbox
VT01	Zone Temp	85.270	<input type="checkbox"/>
VT02	Wiresheet BACnet Status	0.000	<input type="checkbox"/>
VT03	Virtual Point 3	0.000	<input type="checkbox"/>
VT04	Virtual Point 4	0.000	<input type="checkbox"/>
VT05	Virtual Point 5	0.000	<input type="checkbox"/>
VT06	Virtual Point 6	0.000	<input type="checkbox"/>
VT07	Virtual Point 7	0.000	<input type="checkbox"/>
VT08	Virtual Point 8	0.000	<input type="checkbox"/>
VT09	Virtual Point 9	0.000	<input type="checkbox"/>
VT10	Virtual Point 10	0.000	<input type="checkbox"/>
VT11	Virtual Point 11	0.000	<input type="checkbox"/>
VT12	Virtual Point 12	0.000	<input type="checkbox"/>
VT13	Virtual Point 13	0.000	<input type="checkbox"/>
VT14	Virtual Point 14	0.000	<input type="checkbox"/>
VT15	Virtual Point 15	0.000	<input type="checkbox"/>
VT16	Virtual Point 16	0.000	<input type="checkbox"/>
VT17	Virtual Point 17	0.000	<input type="checkbox"/>
VT18	Virtual Point 18	0.000	<input type="checkbox"/>
VT19	Virtual Point 19	0.000	<input type="checkbox"/>
VT20	Virtual Point 20	0.000	<input type="checkbox"/>
VT21	Virtual Point 21	0.000	<input type="checkbox"/>
VT22	Virtual Point 22	0.000	<input type="checkbox"/>
VT23	Virtual Point 23	0.000	<input type="checkbox"/>
VT24	Virtual Point 24	0.000	<input type="checkbox"/>

Schedule Configuration

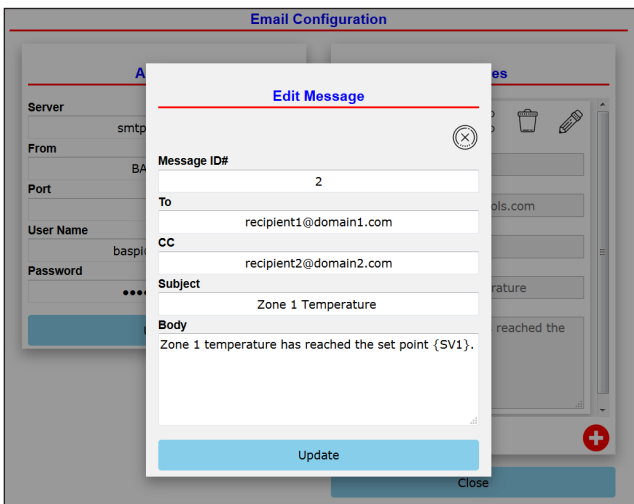
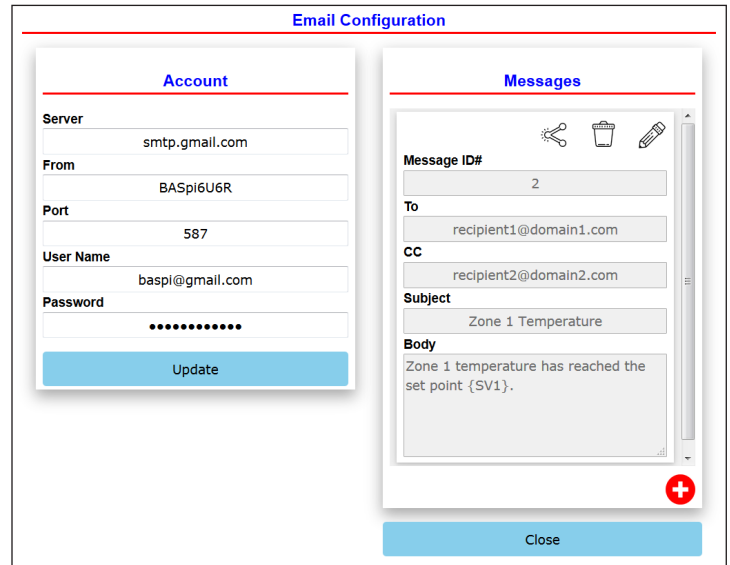
The weekly schedule is web page configurable and allows for entry of special event/holiday schedule exceptions. A schedule Sedona component is used to trigger logic. Default schedule tab displays the default weekly schedule for weeks with no special events/holidays. The Events tab allows entry of special event/holiday schedule exceptions.

The Current Schedule tab shows the current schedule with any special events/holidays for that week. A Sedona schedule component is used to trigger control logic.



Email Configuration

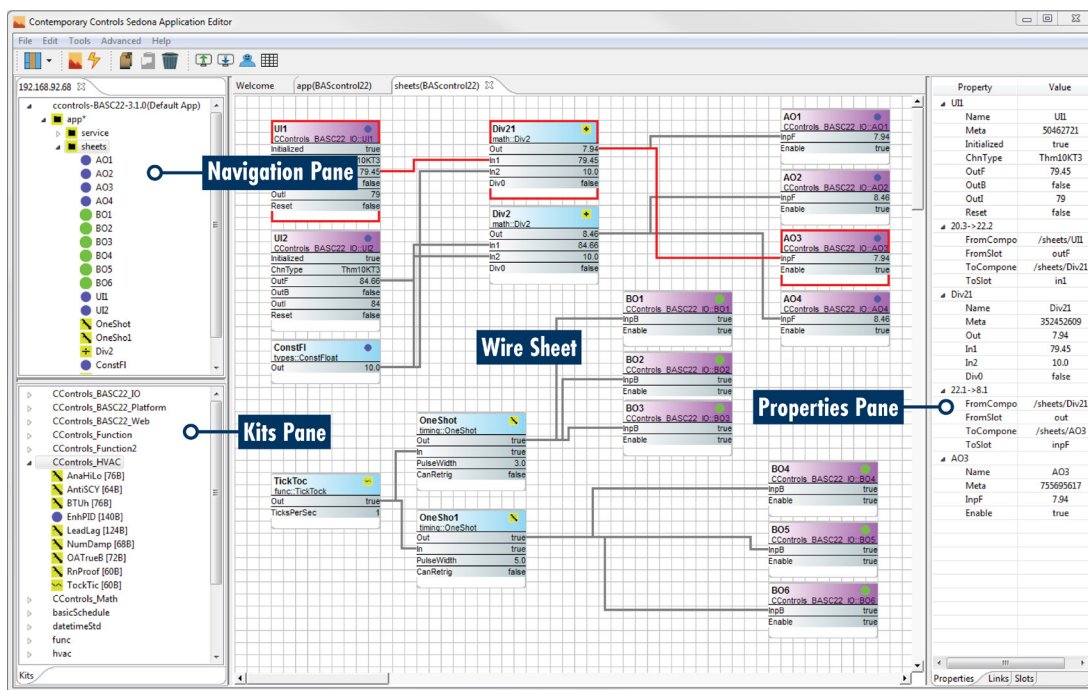
Email alarms are web page configurable and allow for multiple point or wire sheet values to be included in the sent email. Emails can be sent to multiple recipients. An email Sedona component is used to trigger the alarms/notifications.



Powered by a Sedona Virtual Machine – for Implementing Control

The BASpi incorporates Sedona Virtual Machine (SVM) open source technology, originally developed by Tridium. Using tools such as the free Sedona Application Editor, or Tridium established tools such as Niagara Workbench AX, the user can develop a control application using powerful drag-and-drop visual programming methodology. Once developed, the program remains stored in the BASpi and executes by way of the SVM. The application can run standalone in the BASpi, or it can interact with a program in a supervisory BACnet controller over Ethernet or Wi-Fi. The number of potential applications is unlimited. The BASpi includes Tridium’s Sedona 1.2 kits of components — and Contemporary Controls’ enhanced

product-specific and non-product-specific kits. The BASpi IO Kit components provide 12 physical points, 24 BACnet Virtual Points, and 4 Universal Counters. BASpi Web Kit has 48 components which share data with web pages. Input web components receive data from hosted web pages. Output web components send data to hosted web pages. The Contemporary Controls’ Function, Function2, HVAC, and Math kits provide additional components for increased flexibility. A set of kits is pre-installed on the BASpi. In order to install additional compatible kits, use the Kit Manager in Sedona Application Editor (SAE). For complete details on Sedona Framework, SAE, and Sedona component functionality refer to the [Sedona Open Control Reference Manual](#).



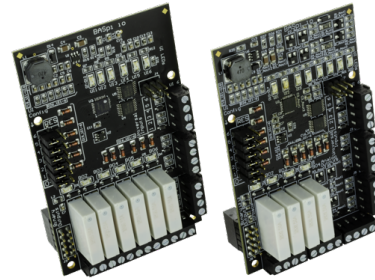
Contemporary Controls' Developed Sedona Components

<p>BASpi I/O Kit BASpi platform specific components</p>	<p>UI1 – UI6 BO1 – BO6 ScanTim Sunrise UC1 – UC4 VT01 – VT24</p>	<p>Universal input – binary, analog voltage, thermistor, resistance or pulse input Binary output – binary output point Scan time monitor – records the min, max and average scan times Calculates minutes to sunrise/sunset based on configured geolocation Universal counters – up/down counters Virtual points – share wire sheet data with BACnet/IP clients</p>
<p>BASpi Web Kit BASpi platform specific components</p>	<p>WC01 – WC48</p>	<p>Web components – share wire sheet data with the BASpi web pages</p>
<p>Contemporary Controls Email Kit Common to Sedona 1.2 compliant controllers with web page support for e-mail alarms</p>	<p>Email</p>	<p>Email - triggered by binary wire sheet logic to send a specified alarm/notification with point values</p>
<p>Contemporary Controls Schedule Kit Common to Sedona 1.2 compliant controllers with web page support for scheduling</p>	<p>Sched</p>	<p>Schedule - binary trigger for wire sheet logic based on web page configured weekly schedule with exceptions</p>
<p>Contemporary Controls Function Kit Common to Sedona 1.2 compliant controllers</p>	<p>Cand2 Cand4 Cand6 Cand8 Cmt Cor2 Cor4 Cor6 Cor8 CtoF Dff FtoC HLpre PsychrE PsychrS SCLatch</p>	<p>Two-input Boolean product – two-input AND/NAND gate with complementary outputs Four-input Boolean product – four-input AND/NAND gate with complementary outputs Six-input Boolean product – six-input AND/NAND gate with complementary outputs Eight-input Boolean product – eight-input AND/NAND gate with complementary outputs Comment – comment field up to 64 characters Two-input Boolean sum – two-input OR/NOR gate with complementary outputs Four-input Boolean sum – four-input OR/NOR gate with complementary outputs Six-input Boolean sum – six-input OR/NOR gate with complementary outputs Eight-input Boolean sum – eight-input OR/NOR gate with complementary outputs °C to °F – Celsius to Fahrenheit Temperature Conversion "D" Flip-Flop – D-style Edge-triggered Single-bit Storage °F to °C – Fahrenheit to Celsius Temperature Conversion High – Low Preset – defined logical true and false states Psychrometric Calculator – English Units Psychrometric Calculator – SI Units Set/Clear Latch – single-bit level-triggered single-bit data storage</p>
<p>Contemporary Controls Function 2 Kit Common to Sedona 1.2 compliant controllers</p>	<p>ASWC ASW4C BSWC ISWC CmprC MAXE</p>	<p>Analog switch — selection between two float variables Analog switch — selection between four floats Boolean Switch — selection between two Boolean variables Integer switch — selection between two integer variables Comparison math — comparison (<=>) of two floats Max Enumeration – maximum integer valve from weighted inputs</p>
<p>Contemporary Controls HVAC Kit Common to Sedona 1.2 compliant controllers</p>	<p>AnaHiLo AntiSCY BTUh EnhPID LeadLag NumDamp OATrueB RnProof TockTic</p>	<p>Initiate an alarm or event for an analog point, or limit the output range of an analog point Protect mechanical equipment from running for too short of a time or restarting without a sufficient delay Calculate the amount of heating or cooling of water that is occurring by Monitor the temperature differential across a piece of equipment and the flow rate in BTU per hour Enhanced PID Loop Controller - if Enable slot becomes false, proportional control ceases and the internal timers and accumulators for integral and derivative action are cleared Monitors and controls up to four devices (usually pumps) dedicated to one critical process Functions as a digital filter to dampen the volatility of an input signal by creating an output version of the input signal but with modifications to the signal's rate-of change and amplitude change Makes a dynamic calculation of the percentage opening of an outside air damper One device (pump or motor) is commanded on and proven to be on otherwise a failure is noted Active counter with clock frequency set in steps per second</p>
<p>Contemporary Controls Math Kit Common to Sedona 1.2 compliant controllers</p>	<p>Add Div Mul Sub</p>	<p>Add the values of two input slots Divide the values of two input slots Multiply the values of two input slots Subtract the values of two input slots</p>

Tridium’s Sedona 1.2 Components

<p>The HVAC Group operations that facilitate control</p>	<p>LSeq ReheatSeq Reset Tstat</p>	<p>Linear Sequencer — bar graph representation of input value Reheat sequence — linear sequence up to four outputs Reset — output scales an input range between two limits Thermostat — on/off temperature controller</p>
<p>The Scheduling Group scheduling operations based upon time of day</p>	<p>DailySc DailyS1 DateTime</p>	<p>Daily Schedule Boolean — two-period Boolean scheduler Daily Schedule Float — two-period float scheduler Time of Day — time, day, month, year</p>
<p>The Function Group convenient functions for developing control schemes</p>	<p>Cmpr Count Freq Hysteresis IRamp Limiter Linearize LP Ramp SRLatch TickTock UpDn</p>	<p>Comparison math — comparison (<=>) of two floats Integer counter — up/down counter with integer output Pulse frequency — calculates the input pulse frequency Hysteresis — setting on/off trip points to an input variable IRamp — generates a repeating triangular wave with an integer output Limiter — Restricts output within upper and lower bounds Linearize — piecewise linearization of a float LP — proportional, integral, derivative (PID) loop controller Ramp — generates a repeating triangular or sawtooth wave with a float output Set/Reset Latch — single-bit data storage Ticking clock — an astable oscillator used as a time base Float counter — up/down counter with float output</p>
<p>The Priority Group prioritizing actions of Boolean, Float and Integer variables</p>	<p>PrioritizedBool PrioritizedFloat PrioritizedInt</p>	<p>Prioritized boolean output — highest of sixteen inputs Prioritized float output — highest of sixteen inputs Prioritized integer output — highest of sixteen inputs</p>
<p>The Types Group variable types and conversion between types</p>	<p>B2F ConstBool ConstFloat ConstInt F2B F2I I2F L2F WriteBool WriteFloat WriteInt</p>	<p>Binary to float encoder — 16-bit binary to float conversion Boolean constant — a predefined Boolean value Float constant — a predefined float variable Integer constant — a predefined integer variable Float to binary decoder — float to 16-bit binary conversion Float to integer — float to integer conversion Integer to float — integer to float conversion Long to float — long integer to float conversion Write Boolean — setting a writable Boolean value Write Float — setting a writable float value Write integer — setting an integer value</p>
<p>The Logic Group logical operations using Boolean variables</p>	<p>ADemux2 And2 And4 ASW ASW4 B2P BSW DemuxI2B4 ISW Not Or2 Or4 Xor</p>	<p>Analog Demux — Single-input, two-output analog de-multiplexer Two-input Boolean product — two-input AND gate Four-input Boolean product — four-input AND gate Analog switch — selection between two float variables Analog switch — selection between four floats Binary to pulse — simple mono-stable oscillator (single-shot) Boolean switch — selection between two Boolean variables Four-output Demux — integer to Boolean de-multiplexer Integer switch — selection between two integer variables Not — inverts the state of a Boolean Two-input Boolean sum — two-input OR gate Four-input Boolean sum — four-input OR gate Two-input exclusive Boolean sum — two-input XOR gate</p>
<p>The Timing Group time-based components</p>	<p>DlyOff DlyOn OneShot Timer</p>	<p>Off delay timer — time delay from a “true” to “false” transition of the input On delay timer — time delay from an “false” to “true” transition of the input Single Shot — provides an adjustable pulse width to an input transition Timer — countdown timer</p>
<p>The Math Group math-based components</p>	<p>Add2 Add4 Avg10 AvgN Div2 FloatOffset Max Min MinMax Mul2 Mul4 Neg Round Sub2 Sub4 TimeAvg</p>	<p>Two-input addition — results in the addition of two floats Four-input addition — results in the addition of four floats Average of 10 — sums the last ten floats while dividing by ten thereby providing a running average Average of N — sums the last N floats while dividing by N thereby providing a running average Divide two — results in the division of two float variables Float offset — float shifted by a fixed amount Maximum selector — selects the greater of two inputs Minimum selector — selects the lesser of two inputs Min/Max detector — records both the maximum and minimum values of a float Multiply two — results in the multiplication of two floats Multiply four — results in the multiplication of four floats Negate — changes the sign of a float Round — rounds a float to the nearest N places Subtract two — results in the subtraction of two floats Subtract four — results in the subtraction of four floats Time average — average value of float over time</p>

BACnet Protocol Implementation Conformance (PIC) Statement



BASpi-IO BACnet/IP Sedona Field Controller

BACnet Protocol Implementation Conformance Statement (Annex A)

Date: April 24, 2020
Vendor Name: Contemporary Controls
Product Name: BASpi-IO
Product Model Number: BASPI-IO6U6R and BASPI-IO6U4R2A
Applications Software Version: 1.2.28 **Firmware Revision:** 1.0.31 **BACnet Protocol Revision:** 3
Product Description: BACnet/IP compliant 12-point field controller or remote I/O that allows a direct connection to Ethernet or WiFi.

- BACnet Standardized Device Profile (Annex L):**
- BACnet Operator Workstation (B-OWS)
 - BACnet Building Controller (B-BC)
 - BACnet Advanced Application Controller (B-AAC)
 - BACnet Application Specific Controller (B-ASC)
 - BACnet Smart Sensor (B-SS)
 - BACnet Smart Actuator (B-SA)

- List all BACnet Interoperability Building Block Supported (Annex K):**
- DS-RP-B Data Sharing — ReadProperty – B
 - DS-WP-B Data Sharing — WriteProperty – B
 - DS-RPM-B Data Sharing — ReadPropertyMultiple – B
 - DS-COV-B Data Sharing — ChangeOfValue – B
 - DM-DDB-B Device Management — Dynamic Device Binding – B
 - DM-DOB-B Device Management — Dynamic Object Binding – B
 - DM-DCC-B Device Management — Device Communication Control – B
 - DM-TS-B Device Management — Time Synchronization – B

- Segmentation Capability:**
- Able to transmit segmented messages Window Size:
 - Able to receive segmented messages Window Size:

Standard Object Types Supported:

Object Type Supported	Can Be Created Dynamically	Can Be Deleted Dynamically
Analog Input	No	No
Analog Value	No	No
Binary Input	No	No
Binary Output	No	No
Binary Value	No	No
Device	No	No

No optional properties are supported.

Data Link Layer Options:

- BACnet IP, (Annex J)
- BACnet IP, (Annex J), Foreign Device
- ISO 8802-3, Ethernet (Clause 7)
- ANSI/ATA 878.1, EIA-485 ARCNET (Clause 8), baud rate(s):
- MS/TP master (Clause 9), baud rate(s):
- MS/TP slave (Clause 9), baud rate(s):
- Point-To-Point, EIA 232 (Clause 10), baud rate(s):
- Point-To-Point, modem, (Clause 10), baud rate(s):
- LonTalk, (Clause 11), medium:
- Other:

Device Address Binding:

Is static device binding supported? (This is currently necessary for two-way communication with MS/TP slaves and certain other devices.) Yes No

Networking Options:

- Router, Clause 6 – List all routing configurations, e.g., ARCNET-Ethernet-MS/TP, etc.
- Annex H, BACnet Tunnelling Router over IP
- BACnet/IP Broadcast Management Device (BBMD)
- Does the BBMD support registrations by Foreign Devices? Yes No

Character Sets Supported:

- Indicating support for multiple character sets does not imply that they can all be supported simultaneously.
- ANSI X3.4
 - IBM™/Microsoft™ DBCS
 - ISO 8859-1
 - ISO 10646 (UCS-2)
 - ISO 10646 (UCS-4)
 - JIS C 6226

If this product is a communication gateway, describe the types of non-BACnet equipment/network(s) that the gateway supports:
 No gateway support.

Specifications

Universal Inputs

Configured As

Analog input

Temperature input

Contact closure input

Pulse input

Resistance

Characteristics

0–10 VDC (+/- 1% precision)

Input impedance 1 MΩ on voltage

Type II 10 kΩ thermistors: –10° to +190 °F (–23.3° to +87.8°C)

Type III 10 kΩ thermistors: –15° to +200 °F (–26.1° to +93.3°C)

20 kΩ thermistors: 15° to 215° F (–9° to +101° C)

Excitation current 0.5 mA. Open circuit voltage 10 VDC.

Sensing threshold 3 VDC (low) and 7 VDC (high). Response time 20 ms.

0–10 VDC for active output devices

0–10 VDC for passive devices (configured for internal pull-up resistor)

40 Hz maximum input frequency with 50% duty cycle.

Web page adjustable high and low thresholds.

1 kΩ -100 kΩ range

Binary Outputs

Binary output

Normally open relay contacts. 30VAC/VDC 2A max

Excitation current 1.2 mA. Open circuit voltage 12 VDC

Sensing threshold 3 VDC (low) and 7 VDC (high). Response time 20 ms

Storage

micro SD card (pSLC industrial grade cards recommended for maximum system stability)

Functional

Protocols supported

Ethernet/Wi-Fi

BACnet/IP, Sedona SOX, HTTP, SMTP (BASpi firmware)

Electrical

Input

Voltage

Power

5 VDC

4 W (with all IO, BASpi firmware, and both networks adapters engaged)

Ordering Information

Model

BASPI-IO6U6R

Description

Raspberry Pi Daughterboard 6UI/6 Relay

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