 CONTENT

- System Overview ........................................ 4
- Power .................................................... 4
- DC Power Jack (J2) & Power Terminal (J3) ........ 4
- User Interface ........................................ 4
- System Overview ........................................ 4
- LCD ...................................................... 4
- Buttons .................................................. 4
- LEDs ..................................................... 5
- Connectivity ........................................... 5
- USB ..................................................... 5
- JTAG .................................................... 5
- RS485 .................................................... 6
- BACnet .................................................. 6
- General Features ...................................... 6
- SD Card .................................................. 6
- DIP Switches .......................................... 6
- Master Controls ....................................... 7
- Rain Sensor Input (Required) ....................... 7
- Heating Interlock Input (Optional) ................. 7
- Fire Alarm Input (Optional) ......................... 7
- Smoke Vent Input (Optional) ....................... 7
- External Temperature Input (Required) .......... 7
- Fault Output (Optional) ............................... 7
- Fireman’s Key Switch Input (Optional) ............ 8
- Competition Key Switch Input (Optional) ......... 8
- Zone Inputs/Outputs .................................. 8
- Damper/Louvre Connection ......................... 8
- Wall Actuator Connection ......................... 8
- RS485 Digital Interface ............................. 9
- Real-time Clock Backup Battery .................... 6
- Reset Button .......................................... 6
- Additional I/O ......................................... 9
- BMS I/O ............................................... 9
- General Purpose Inputs.............................. 9
- Heating Solid-State Relays ......................... 9
- Cooling Solid-State Relays ......................... 9
- Control Strategy ..................................... 10
- CO₂ Control ........................................... 10
- Night-time cooling ................................... 11
- Input Priority List ................................... 11
- Other Information .................................... 11
- Additional Temperature Sensor and averaging ... 11
- Zone Usage ........................................... 11
The iNVent 2 Control system is a microprocessor based system to control four zones of Monodraught Natural Ventilation systems. It is the successor of the iNVent control panel and by default operates in the same way, yet has a range of additional features and flexibility that allows it to do so much more.
**Power**

The iNVent 2 control panel is powered by an external 60W switched mode power supply that converts 240V AC to 24V DC. This 24V DC supply is distributed throughout the panel via resettable fuses to each of the 4 Zones, as well as to the other auxiliary 24V feeds. The 24V DC is also stepped down to 3.3V which is used to power all the control circuitry on the PCB. This means that the 24V feed to a connected product can be shorted without affecting the operation of the panel or the rest of the connected devices.

The External SMPS has a current limit of 2.5A, but in actual use, this needs to be de-rated to 2A in order to accommodate surge currents when the unit is powered on.

**DC Power Jack (J2) & Power Terminal (J3) (3.1)**

The DC power Jack (J2) is used to connect power to the panel from the external power supply, and is centre positive.

The Power Terminal (J3) is for future use when the power supply will be integrated within a new design case.

**User Interface**

iNVent 2 uses an LCD, buttons and LEDs to communicate its operation to the user.

**LCD (4.1)**

The 20 x 4 Character LCD is the primary method of displaying information about the iNVent 2 panel. It provides information on all the configuration settings, as well as the current status of the control panel. By default, it shows a splash screen with the model, date/time and system status. Through the use of buttons, the screen can be navigated through a number of pages of information.

**Buttons (4.2)**

**Page Button**

The Page button changes the screen between the global information and cycles through the 4 zones.

**Scroll Button**

The Scroll button scrolls the information shown for the global or zone page displayed. A long press of this button will change the status information between values and voltages (i.e. % <-> V).

**LEDs**

iNVent 2 uses a number of LEDs to display status information to the user.

**Zone 24V Power LEDs (4.3.1)**

Each zone has a green LED to the left of the Damper/Louvre Terminal which indicates the status of the 24V power available for that zone. If the LED is
illuminated, then the 24V power for that zone is active. If too much current is drawn through a short circuit or because of overloading by too many devices, the resettable fuse will trip until the load is reduced to acceptable levels and the LED will turn off. These LEDs are marked on the PCB as LED1, LED5, LED10 and LED17.

**Auxiliary 24V Power LED**

The external temperature sensor, rain/heat connector, RS485 4-way terminal and general purpose inputs are supplied by the auxiliary 24V which is protected from the main 24V supply by a resettable fuse. Any shorts or overloads on these connections will trip the fuse, removing power from these connections and causing LED3 (located between the buttons and the 4-way RS485 terminal) to turn off.

**USB Communications, Heartbeat, and Power LEDs (4.3.3)**

The cluster of 4 LEDs below the USB port are used to indicate communications over the USB port, as well as indicating the presence of 3.3V power to the control circuitry and operational status of the panel.

LED 2 indicates data transmission to the PC, whilst LED 4 indicates data transmission from the PC.

LED 6 indicates that there is 3.3V on the PCB, which means that the control circuitry is powered. If 24V has been connected to the panel but the power LED does not illuminate, then there is a fault in the panel’s 24V to 3.3V power supply.

LED 7 is the heartbeat LED and the purpose of the LED is to flash intermittently to indicate that the system is active and operational. If this light fails to flash, then there is an issue with the control circuitry or firmware.

**Heating and Cooling LEDs (4.3.4)**

The 4 x Heating and 4 x Cooling solid state relays are silent in operation, so LED 8-9 and LED 11-16 show the status of the SSRs. The green LEDs indicate that the corresponding cooling relay is active and the red LEDs indicate that the corresponding heating relay is active. Each LED is positioned to the right of the terminal it corresponds to.

**Fault LED (4.3.5)**

The Fault output is a solid state relay and has an LED to indicate its operation. When the panel is off or a fault has occurred, the relay de-energises and LED 18 turns off. If LED 18 is on, then it indicates that the system is OK and operating normally.

**Connectivity**

- **USB (5.1)**

  The USB type B socket (J7) on iNVent 2 allows an engineer to connect to the panel in order to see the status and configuration of the panel via the iNVent Configurator software. This enables the iNVent 2 panel to be reconfigured to operate in more advanced and custom configurations than the default configuration.

- **JTAG (5.2)**

  The JTAG programming connector (K1) is used for programming new firmware to the panel using an ST Microelectronics STLinkV2 programmer. It is also used for internal development of new firmware.
**General Features**

This section describes extra features of the iNVent 2 panel not covered by other categories.

- **RS485 (5.3)**
  The general RS485 connector (J1) is a 4-way terminal that provides 24V DC power and RS485 differential signals to an external device that communicates over RS485. This is for future functionality and is not yet implemented in firmware or in the iNVent Configurator.

- **BACnet (5.4)**
  The BACnet module socket (A1) allows the optional BACnet module from Cimetrics to be installed into the iNVent 2 panel in order to make system status information available on a BACnet network, if desired by the customer. Only BACnet/IP is supported and requires an Ethernet connection and a static IP address. Please see the iNVent 2 - Optional BACnet module product card for further information.

- **SD Card (6.1)**
  iNVent 2 has an SD card socket which is used to data-log the system operation. 2 types of file are created on the SD card, a data-log of the system status and an event log of notable events. This data can be used to analyse the operation of an iNVent 2 system and associated products to provide case study analysis of how the system is performing and allows Monodraught engineers to analyse the data in order to improve on the system performance. 2GB cards have been tested, but larger capacities should also be supported.

- **DIP Switches (6.2)**
  The DIP switches on iNVent 2 provide some alternative functions /operational modes. At the moment these are only used for testing purposes. They must all be set to “OFF” to ensure normal operation.

- **Real-time Clock/Backup Battery (6.3)**
  The iNVent 2 panel has a built-in real-time clock which it uses for various functions such as time-stamping data logs, calculating the current season and providing out of hours closure of automated windows. It uses a CR2032 battery in order to maintain the time and date when the power is off to the panel. The battery should last 5 years with no power to the panel. When the panel is powered, the battery is not used.

  In order to satisfy different markets, iNVent 2 is provided with UTC, Coordinated Universal Time, and Local Time. iNVent 2 will display the local time to the user and for data logging purposes it saves the data in UTC in order to simplify the analysis of the data, especially when daylight savings is enabled.

- **Reset Button (6.4)**
  If the panel needs to be reset for some reason, instead of cycling the power, the micro-controller can be reset using the reset button (S3).
**Master Controls**

- **Rain Sensor Input (Required) - (7.1)**
  The Rain Sensor Input requires a normally open volt-free contact wired between the “COM” and “NO” “Rain” terminals of J28 (upper level).

  When the contact is closed the system will close the active louvres and windows, but leave internal dampers on X-AIR systems and wall louvres in their position based on the temperature/CO\textsubscript{2} to allow continued ventilation in the space. If the ventilation system is a WINDCATCHER Classic or SOLA-BOOST system, then the dampers will fully close on rain.

- **Heating Interlock Input (Optional) - (7.2)**
  The Heating Interlock input requires a normally open volt-free contact wired between the “COM” and “NO” terminals of the J28 “Heat” terminals (lower level).

  When the contact is closed the system will limit all dampers, wall louvres and windows to a maximum of 10% open as default. This may be altered to anything in the range of 5% to 20% in 5% increments via the iNVent 2 configurator software.

- **Fire Alarm Input (Optional) - (7.3)**
  The Fire Alarm input requires a normally open volt-free contact wired between the “COM” and “NO” terminals of the J33 “Fire” terminals (lower level).

  When the contact is closed all dampers, louvres, wall louvres and windows will fully close.

- **Smoke Vent Input (Optional) - (7.4)**
  The Smoke Vent input requires a normally open volt-free contact wired between the “COM” and “NO” terminals of the J33 “Smoke” terminals (upper level).

  When the contact is closed all dampers, louvres, wall louvres and windows will open to allow the escape of smoke.

- **External Temperature Input (Required) - (7.5)**
  The external temperature input requires a weather-proof temperature sensor with a 0-10V output that maps to -10°C to +40°C, powered by 24V DC, connected to J34. One such suitable sensor is the Titan Products part ref: TPVOS.

  This should be located out of direct sunlight and away from any heat sources that could affect the air temperature measurement (such as plant exhaust). It is recommended that it is installed on a north facing façade of the building. If it is located on any other façade it will require shielding by building soffits or by a type of solar shielding.

  It is used to adjust the seasonal strategy and protect ventilation systems against snow/frost.

- **Fault Output (Optional) - (7.6)**
  The fault output is a volt-free contact which when open indicates a fault has occurred. Max rated voltage: 24V DC.
There are 4 physical Zone Input/Outputs which are used to control Monodraught Natural Ventilation systems. They can be reconfigured via the iNVent Configurator tool through the USB port to support other systems or non-standard/new configurations. Each zone comprises of the following:

### Damper/Louvre Connection (8.1)

There are 4 physical Zone Input/Outputs which are used to control Monodraught Natural Ventilation systems. They can be reconfigured via the iNVent Configurator tool through the USB port to support other systems or non-standard/new configurations. Each zone comprises of the following:

1. 0V DC
2. 2 - 10V Damper Control Signal
3. 2 - 10V Damper Position Feedback Signal
4. 2 - 10V Louvre Control Signal
5. 2 - 10V Louvre Position Feedback Signal
6. 24V DC Power

### Wall Actuator (8.2)

The Wall Actuator connection is used to control a Belimo actuator used within Monodraught Ventsair systems or Window Actuator Control Units. The terminals are wired for Ventsair units as follows, from left to right:

1. 0V DC
2. 2 - 10V Wall Actuator Control Signal
3. 2 - 10V Wall Actuator Position Feedback Signal
4. 24V DC Power

---

**Fireman’s Key Switch Input (Optional) - (7.7)**

The Fireman’s Key Switch Input provides two volt-free contacts between “COM” and “O” for open, and “COM” and “C” for close. When the “Open” contact is closed, all dampers, louvres, wall louvres and windows will open. When the “Close” contact is closed, all dampers, louvres, wall louvres and windows will close. If both the “Open” and “Close” inputs are activated at the same time by an external system, then the “Close” setting will take priority. The system runs in normal mode when neither of the contacts are activated.

This is usually connected to a Monodraught 3-position Fire Key Switch.

**Competition Key Switch Input (Optional) - (7.8)**

The Competition Key Switch Input provides two volt-free contacts between “COM” and “O” for open, and “COM” and “C” for close. When the “Open” contact is closed, all dampers, louvres, wall louvres and windows will open. When the “Close” contact is closed, all dampers, louvres, wall louvres and windows will close to the competition mode setting between 5% and 20% (default of 10%). If both the “Open” and “Close” inputs are activated at the same time by an external system, then the “Close” setting will take priority. The system runs in normal mode when neither of the contacts are activated.

This is usually connected to a Monodraught 3-position Competition Key Switch.

---

**Zone Inputs/Outputs**

There are 4 physical Zone Input/Outputs which are used to control Monodraught Natural Ventilation systems. They can be reconfigured via the iNVent Configurator tool through the USB port to support other systems or non-standard/new configurations. Each zone comprises of the following:

1. 0V DC
2. 2 - 10V Damper Control Signal
3. 2 - 10V Damper Position Feedback Signal
4. 2 - 10V Louvre Control Signal
5. 2 - 10V Louvre Position Feedback Signal
6. 24V DC Power
**RS485 Digital Interface (8.3)**

The RS485 Digital Interface is for future support of digital communication between Monodraught products. Currently there are no products that support this, but this section will be updated when they have been developed. Currently it provides 24V power and an RS485 connection over a RJ45 terminated CAT5 cable, but MUST NOT BE CONFUSED WITH ETHERNET.

**Sensor 1/2 Input (8.4)**

The Sensor 1 and 2 inputs are used to connect to Monodraught sensors and wall controllers, as well as any other sensors that output a 0-10V signal. By default, Sensor 1 is configured as a Monodraught WINDCATCHER Wall Mounted Controller, and Sensor 2 is configured as an additional 0-50°C temperature sensor. This means that by default, iNVent 2 operates the same way as an iVent 1 panel.

The terminals are wired as follows, from left to right:

1. 0V DC
2. 0 - 10V Input from Sensor
3. 24V DC Power

**Additional I/O**

**BMS I/O (9.1)**

The BMS I/O connections (J17) allow the iNVent 2 panel to send or receive signals to/from a BMS system for tighter control and integration. It provides four 0 - 10V outputs, and four 0 - 10V inputs which can be configured for a variety of purposes.

An example of this is getting the BMS system to send the room temperature that it reads and uses for the control of other systems, such as heating, to the iNVent 2 panel so that one common measurement is used to prevent cooling/heating system fighting or oscillation. It can also operate in reverse, so that the BMS uses the temperature measurements that the iNVent 2 panel measures to base the operation of other building systems on.

**General Purpose Inputs (9.2)**

The general purpose inputs (J21 & J25) provide four 0 - 10V inputs and 24V DC power to additional devices or sensors. These can be configured to operate with a wide variety of sensors through the iNVent 2 configurator software.

**Heating Solid State Relays (9.3)**

The iNVent 2 panel has four solid state relays (Lower terminals of J15, J18, J22, J26) for controlling a heating system per zone. This is not currently supported, but will be in a future release of firmware. It is a volt-free contact rated at 24V, 1A maximum.

**Cooling Solid State Relays (9.4)**

The iNVent 2 panel has four solid state relays (Upper terminals of J15, J18, J22, J26) for controlling a cooling system per zone. This is not currently supported, but will be in a future release of firmware. It is a volt-free contact rated at 24V, 1A maximum.
The iNVent 2 panel uses a Seasonal Automatic Temperature Control strategy to manage the air quality and room temperature of a zone. It varies the damper and louvre openings of Monodraught Natural Ventilation systems based on the internal and external temperatures, and adjusts for the current season.

<table>
<thead>
<tr>
<th>Season</th>
<th>Spring</th>
<th>Summer</th>
<th>Autumn</th>
<th>Winter</th>
</tr>
</thead>
<tbody>
<tr>
<td>Start Date</td>
<td>01 March</td>
<td>01 June</td>
<td>01 September</td>
<td>01 December</td>
</tr>
<tr>
<td>Finish Date</td>
<td>31 May</td>
<td>30 August</td>
<td>30 November</td>
<td>Last Day of Feb</td>
</tr>
</tbody>
</table>

### Zone Temperature

<table>
<thead>
<tr>
<th>Temperature</th>
<th>Damper Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>Up to 16°C</td>
<td>Dampers Closed</td>
</tr>
<tr>
<td>At 17°C</td>
<td>Dampers Open 20%</td>
</tr>
<tr>
<td>At 18°C</td>
<td>Dampers Open 40%</td>
</tr>
<tr>
<td>At 19°C</td>
<td>Dampers Open 60%</td>
</tr>
<tr>
<td>At 20°C</td>
<td>Dampers Open 20%</td>
</tr>
<tr>
<td>At 21°C</td>
<td>Dampers Open 40%</td>
</tr>
<tr>
<td>At 22°C</td>
<td>Dampers Open 60%</td>
</tr>
<tr>
<td>At 23°C</td>
<td>Dampers Open 80%</td>
</tr>
<tr>
<td>At 24°C</td>
<td>Dampers Fully Open</td>
</tr>
<tr>
<td>At 25°C</td>
<td>Dampers Open 40%</td>
</tr>
<tr>
<td>At 26°C</td>
<td>Dampers Open 50%</td>
</tr>
</tbody>
</table>

**Night-time Cooling**

- X
- ✓
- X
- X

**ActivLouvre Opening**

- 50%
- 100%
- 50%
- 25%

The external temperature is also used to activate Frost Mode. This mode closes the louvres if the external temperature is below 5°C in order to ensure that the louvres do not freeze open. If the external temperature is less than 8°C and the rain sensor activates, then the system enters Snow Mode and closes the louvres.

During hotter weather, if required, dampers can be set to close when the internal temperature is at least 25°C and the external temperature is at least 5°C above the internal temperature. This feature is designed to prevent a space from heating up due to higher outside air temperatures (i.e. 30°C outside, 25°C inside).

In addition to the above control strategy the system will cycle the Active Louvre fully each day at 2.00 am to ensure there is no dirt build up that may inhibit the movement brought on by a long period of the louvres not actuating fully.

Further to the seasonal position of the louvres the over-ride open facility no longer fully opens the louvres fully every time but will move the louvres to the position of the next season as indicated in Table 3 below.

### Table 1 - Damper and Louvre Operational Strategy

<table>
<thead>
<tr>
<th>Season</th>
<th>Damper Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>Start Date</td>
<td>01 March</td>
</tr>
<tr>
<td>Finish Date</td>
<td>31 May</td>
</tr>
<tr>
<td>Zone Temperature</td>
<td>Damper Output</td>
</tr>
<tr>
<td>Up to 16°C</td>
<td>Dampers Closed</td>
</tr>
<tr>
<td>At 17°C</td>
<td>Dampers Open 20%</td>
</tr>
<tr>
<td>At 18°C</td>
<td>Dampers Open 40%</td>
</tr>
<tr>
<td>At 19°C</td>
<td>Dampers Open 60%</td>
</tr>
<tr>
<td>At 20°C</td>
<td>Dampers Open 20%</td>
</tr>
<tr>
<td>At 21°C</td>
<td>Dampers Open 40%</td>
</tr>
<tr>
<td>At 22°C</td>
<td>Dampers Open 60%</td>
</tr>
<tr>
<td>At 23°C</td>
<td>Dampers Open 80%</td>
</tr>
<tr>
<td>At 24°C</td>
<td>Dampers Fully Open</td>
</tr>
<tr>
<td>At 25°C</td>
<td>Dampers Open 40%</td>
</tr>
<tr>
<td>At 26°C</td>
<td>Dampers Open 50%</td>
</tr>
<tr>
<td>Night-time Cooling</td>
<td>X</td>
</tr>
<tr>
<td>ActivLouvre Opening</td>
<td>50%</td>
</tr>
</tbody>
</table>

The iNVent 2 control system will adjust the active seasonal strategy depending upon the external temperature based on the following table:

### Table 2 - Seasonal Strategy Based on Noon External Temperatures

<table>
<thead>
<tr>
<th>External Temperature (ET)</th>
<th>Spring</th>
<th>Summer</th>
<th>Autumn</th>
<th>Winter</th>
</tr>
</thead>
<tbody>
<tr>
<td>ET &lt; 8°C</td>
<td>Winter</td>
<td>Spring</td>
<td>Winter</td>
<td>Winter</td>
</tr>
<tr>
<td>8°C &lt; ET &lt; 15°C</td>
<td>Spring</td>
<td>Spring</td>
<td>Autumn</td>
<td>Winter</td>
</tr>
<tr>
<td>15°C &lt; ET &lt; 22°C</td>
<td>Spring</td>
<td>Summer</td>
<td>Autumn</td>
<td>Spring</td>
</tr>
<tr>
<td>ET &gt; 22°C</td>
<td>Summer</td>
<td>Summer</td>
<td>Summer</td>
<td>Spring</td>
</tr>
</tbody>
</table>

### Table 3 - Louvre Override Open Position vs. Season

<table>
<thead>
<tr>
<th>Override Open Position</th>
<th>100%</th>
<th>100%</th>
<th>100%</th>
<th>50%</th>
</tr>
</thead>
</table>

**CO₂ Control (requires controller within the zone to have integrated CO₂ sensor)**

If the CO₂ level in the zone exceeds 1500 ppm the system will open the dampers 20% further than the current setting if they are currently open 20% to 80% otherwise they open to 20%.

If after 5 minutes the CO₂ level is still > 1300 ppm the dampers will open a
Night-time Cooling

During the summer season between the hours of 00:00 and 6:00 am the system will automatically open the dampers and Louvres in all zones where the measured temperature is > 16°C.

This pre-cools the space ready for the next day and can reduce the peak temperature for the following day.

Input Priority List

There are priorities associated with each input so that certain inputs override others, such as Fire Alarm input overriding the CO\textsubscript{2} mode. This is shown in Table 4 below. The CO\textsubscript{2} and heating interlock priorities can be swapped via configuration settings.

<table>
<thead>
<tr>
<th>Input</th>
<th>Priority</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fire Key Switch</td>
<td>Highest</td>
</tr>
<tr>
<td>Fire Alarm</td>
<td></td>
</tr>
<tr>
<td>Competition Switch</td>
<td></td>
</tr>
<tr>
<td>Override Open</td>
<td></td>
</tr>
<tr>
<td>Override Close</td>
<td></td>
</tr>
<tr>
<td>Rain/Snow/Frost Protection</td>
<td></td>
</tr>
<tr>
<td>CO\textsubscript{2}</td>
<td></td>
</tr>
<tr>
<td>Heating Interlock</td>
<td>Lowest</td>
</tr>
<tr>
<td>Temperature</td>
<td></td>
</tr>
</tbody>
</table>

Note: If the dampers are already at 100% they do not open any further.

Additional Temperature Sensor and Averaging

The Additional Temperature sensor is auto detected at power up and is used with the integrated sensor in the zone controller (SOLA-BOOST or WINDCATCHER) to give an average temperature in a larger zone, unless selected otherwise using the iNVent Configurator software.

Zone Usage

Maximum of 3 SOLA-BOOST (Classic / X-Air) systems (Power tracks) can be connected to one zone (controller) or a maximum of 3 WINDCATCHER (Classic / X-Air) systems (Damper Motors) can be connected to one zone. If the large dampers with 2 actuators are used or SUNCATCHER’s (a maximum of 6 per Panel) are installed be aware that the system can only accommodate a maximum of 24 Belimo’s.
Monodraught

Halifax House, High Wycombe
Buckinghamshire, HP12 3SE
+44 (0) 1494 897700
www.monodraught.com
info@monodraught.com

Follow us on: