Zen IoT Gateway

Edge Processing Device

- **4, 12, or 16 Universal Isolated Inputs**
  T/C, RTD, mA, mV, V, Potentiometer and more
- **Optional WiFi**
- **Optional Bluetooth Low Energy (BLE)** for configuration and local control
- **Built in support for 3G/4G modems**
- **Built in realtime clock and datalogger**
- **Scripting logic engine** for custom applications
- **Wide connection to leading Cloud service providers**
- **Low power design** with selectable sleep options
- **Easy USB programming and data log retrieval via your PC:**
  defineinstruments.com/workbench

E2180

General Description

The Zen IoT brings measurement and control, and the *Internet Of Things* together. This new genre of products is ideal for many applications, including AMR (Automatic Meter Reading), remote monitoring of assets, and data collation and transmission.

The Zen IoT is ideal for use as a bridging device, to connect existing infrastructure like PLCs and discrete control systems to the Cloud. It can also be used for edge processing, where data is collated from sensors and existing equipment, calculations are performed in the device, and the results are communicated to the Cloud.

A wide range of communication options are available to connect to other devices, and to the Cloud, using existing industrial protocols like Modbus, and new IoT comms like MQTT. Physical connections include Ethernet, WiFi, 3G/4G, RS485 and Bluetooth.

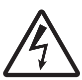
The Zen IoT features a unique low power design which can be programmed to start at power levels of less than 1⁄20W, making battery packs and solar panel systems smaller and more cost effective. The unit also features industrial grade analog and digital I/O, with 4–20mA, RTD, TC and many more available options.

The Zen IoT has an advanced and flexible logic engine which can be programmed with a powerful scripting language (developed by Define Instruments), to tie all these features together for custom applications. (Please contact us to discuss your project.)

The standard Zen IoT 4 has four isolated universal input channels, and comes in a compact 1.38" (35mm) case. This can be expanded to 12 inputs (2.36" [60mm] case) or 16 inputs (3.35" [85mm] case).

CONTENTS

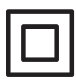
Symbol Definitions



CAUTION
Risk of electric shock
Please refer to user manual.

CAUTION
Risk of danger
Please refer to user manual.

Direct current.



Equipment protected throughout by DOUBLE INSULATION or REINFORCED INSULATION.

ORDER CODES

ZEN–IOT	–		–	
Zen IoT		Channel Configuration		Comm Port(s)

Channel Configuration	**4** **12** **16**	4 universal inputs, standard 1.38" (35mm) case 12 universal inputs, expanded 2.36" (60mm) case 16 universal inputs, expanded 3.35" (85mm) case
Comms	 **RS** **EIOT** **WIFI**	Built in RS485/232 only Built in RS485/232 + Additional RS485/232 Built in RS485/232 + Additional Ethernet IoT Built in RS485/232 + Additional WiFi

Note: Bluetooth and Ethernet Modbus TCP Comms are also supported by this device and are offered to OEM's, subject to MOQ's. Please inquire.

Accessories

Bridge Key	**BRIDGE-KEY**	USB Bridge Key, required for PC programming using our free WorkBench software
Cellular Modem	**GT-HE910-NAD**	GateTel cellular modem for 3G/4G connections

SAFETY NOTICES

For your safety and the prevention of damage to the Zen IoT unit and other equipment connected to it, **please read complete instructions prior to installation and operation of the Zen IoT and carefully observe all safety regulations and instructions. Consult this manual carefully in all cases where hazard symbols are marked on the Zen IoT unit.**

Use of this instrument in a manner not specified by the manufacturer may compromise the protection provided by the instrument. This instrument should not be used to directly drive valves, motors, or other actuators, unless equipped with appropriate safeguards.

It is the responsibility of the user to identify potential hazards that may arise in the event of a fault to unit, and implement safeguards for the prevention of harm to persons or equipment. The safety of any system incorporating this unit is the responsibility of the assembler of the system.

1 CLOUD CONNECTION OPTIONS

The Zen IoT supports a range of options to connect to the internet. These include:

Wired Ethernet Port

An Ethernet port (order code 'EIOT') is available for wired internet connection. (Ethernet Modbus TCP is also supported by this instrument and is available to OEM's on request.)

WiFi

WiFi connection (order code 'WIFI') enables LOS transmission of up to 1476ft (450m) using the supplied 3dBi wireless antenna.

External 3G or 4G modem

An external 3G or 4G modem may be used for remote devices, and is especially useful when other connections are not an option. The Zen IoT supports 3G/4G modems by default via the included RS485 serial port. (You can also order an additional RS485 comm if required for connection to your PLC.) The external modem supported at this time is the GateTel GT-HE910-NAD with type approval for AT&T and T-Mobile.

Once you have decided on a Cloud connection option, Define WorkBench (see Section 6) can then be used to configure your Cloud/server connection settings. Currently supported Cloud platforms are *Xively* and *deviceWISE* (please contact us if your preferred Cloud provider is not listed).

A *Custom* connection can also be used to connect to your own server or that of a third party. The *Custom* connection is secured using TLS and uses MQTT as the protocol transfer mechanism. It sends JSON packets containing the industry standard SenML (Sensor markup language) data.

2 OPERATING MODES

2.1 - WiFi Operating Modes

Station Mode

The most common operating mode for WiFi enabled Zen IoT's is the **Station (or Client) Mode**. This mode is used when the Zen IoT is required to connect to an access point of an existing WiFi network as a client.

Depending on the plugin, it can be set up to work with a DHCP server (default setting), or to have a fixed (or Static) IP address. The user must enter the SSID and passphrase of the WiFi network that it is attempting to connect to.

Access Point Mode

Some WorkBench plugins also allow a WiFi enabled Zen IoT to be run as an access point which is totally independent of any other networks. This can be useful if there are no WiFi networks available, or if they are not accessible for security reasons.

When running in **Access Point Mode**, the Zen IoT will function as a DHCP server and can work with up to 5 Clients. The user can set the SSID, passphrase, and also which WiFi channel to use.

2.2 - Sleep Mode

The Zen IoT has a low power **Sleep Mode** which allows it to run on low current, to conserve power. This is useful for battery powered applications. **Sleep Mode** is installed with selected Cloud plugins in Define WorkBench, and can be enabled from the 'Logging' tab.

In **Sleep Mode** the Zen IoT will wake up periodically to sample analog input data and take a data log sample. It will also publish data to a Cloud server, (if this feature is enabled), before returning to **Sleep Mode**.

When running in **Sleep Mode** the following features are disabled to conserve power:

- Power LED is turned off
- WiFi/Ethernet/Bluetooth functionality is disabled
- RS232/RS485 serial port(s) are disabled
- Relays are disabled (except for Relay D, with retains its state during shut down)
- Analog inputs are disabled

The 4 digital inputs on the Zen IoT remain active in **Sleep Mode** and can still be used as pulse counters with flow transducers etc. (See Section 3 Specifications for reduced count rates during **Sleep Mode**).

Note: The Zen IoT will not enter **Sleep Mode** while a programing cable is inserted into the programming port on the front of the unit and connected to a PC via the Bridge Key. It will exit **Sleep Mode** if an active programming plug is inserted.

3 SPECIFICATIONS

General specifications

Power supply Battery Low Voltage, 10–30V DC

Linearity & repeatability <±0.1% FSO

Channel separation 125db minimum

RF immunity <±1% effect FSO typical

Noise immunity (CMRR) 160dB tested at 300V RMS 50Hz

Permanent memory (E^2ROM) 100,000 writes per input parameter

Analog input

Universal isolated analog inputs
Zen IoT 4: 4 Input channels
Zen IoT 12: 12 Input channels
Zen IoT 16: 16 Input channels
See Section 8 for input specifications and wiring

Input isolation 2,500V AC 1 minute between all input channels

Isolation test voltage 1000V DC for 1min (Analog input to digital output, Analog input to analog input)

Input resolution 16 bits

Accurate to <±0.1% FSO (unless otherwise stated in Section 8)

Relay output

1 x latching relay output 1A, 30V DC (Form C)

3 x solid state relays 0.4A, 30V DC (Form A)

Digital input

4 x Digital inputs

Functions Status, up counter, up/down counter with direction, debounced counter, frequency, gated frequency

Counter register output 32 bit

Frequency range 0–10,000Hz (Reduced to 0–1,000Hz in Sleep Mode)

Input types NPN, Clean Contact, Voltage 2–30V DC

Threshold 1.2V typical

Debounce counter range 0–100Hz

Isolation Not isolated to power supply

Comms

Protocols Modbus RTU, RS485, RS232 or Define ASCII

Default comm port RS485 / RS232 auto-select. Selectable baud rate 2400–230000 baud. Format 8 bit, no parity, 1 stop

Optional additional comm (front panel) Select WiFi, Ethernet IoT or RS485/232 (auto-detecting)

Isolation test voltage 1000V DC for 1min (Comm to analog input, Comm to digital input/output)

Programming

USB programmable Via 'PC Setup' port using Bridge Key USB programmer (sold separately)

Define WorkBench Simple configuration using Define WorkBench. Free download at: defineinstruments.com/workbench

Datalogging

Real-time clock

Data logging 32MB (31,774 samples for all channels)

Fast, simple data log retrieval and visualization, using Define WorkBench

Environmental conditions

Operating temp –40 to 176°F (–40 to 80°C)

Storage temp –40 to 176°F (–40 to 80°C)

Operating humidity 5–85% RH max, non-condensing

Compliances

EN-61326-1:2006

EMC Emissions EN 558022-A; Immunity EN 50082-1; Safety EN 60950

Construction

Casing DIN 35 rail mounting; Material: ABS inflammability V0 (UL94)

Dimensions (H x W x D)

Zen IoT 4 =	3.98 x 1.38 x 4.72" (101 x 35 x 120mm)
Zen IoT 12 =	3.98 x 2.36 x 4.72" (101 x 60 x 120mm)
Zen IoT 16 =	3.98 x 3.35 x 4.72" (101 x 85 x 120mm)

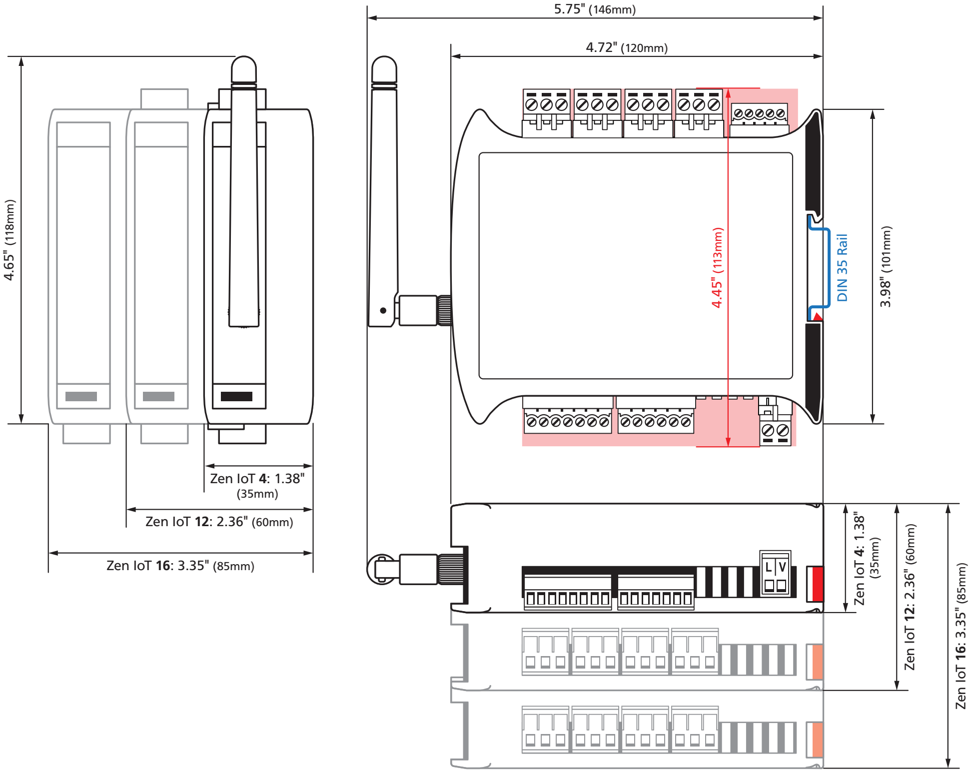
Height with antenna
4.65" (118mm), WiFi model only

Unit weight

ZEN-IOT-4 =	6.9oz (196g)
ZEN-IOT-4-EIOT =	7.8oz (221g)
ZEN-IOT-4-WIFI =	7.8oz (222g)
ZEN-IOT-12 =	11.0oz (312g)
ZEN-IOT-12-EIOT =	12.0oz (341g)
ZEN-IOT-12-WIFI =	12.1oz (342g)

4 DIMENSIONS & INSTALLATION

4.1 - Case Dimensions



4.2 - Installation Environment

The Zen IoT should be installed in a location that does not exceed the maximum operating temperature, and at a safe distance from other devices that generate excessive heat. The installation environment should provide good air circulation to the unit.

The plastic casing and product label may be cleaned, if required, using a soft, damp cloth and neutral soap product. **Caution should be exercised when cleaning the unit to avoid water dripping inside, as this will damage the internal circuits.**

4.3 - Installation Instructions

The Zen IoT is rated IP20, and should be mounted in a protective enclosure to protect the unit from weather conditions and dust. If using the Zen IoT with WiFi, the unit must be located within range of a WiFi network. The maximum distance is 1476ft (450m) L.O.S.

A - Plastic Enclosure (Fig 1)

Prepare the **Plastic Enclosure** (not supplied) as illustrated by mounting a **DIN 35 rail**, cable glands, and any other required components.

If you are using the WiFi model, the antenna may be mounted directly on the Zen IoT (inside the **Plastic Enclosure**). A cellular modem may also be installed inside the enclosure.

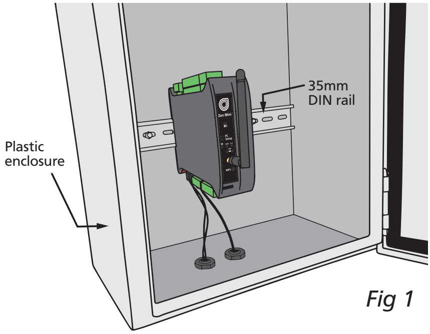


Fig 1

B - Metal Enclosure (Fig 2)

Prepare the **Metal Enclosure** (not supplied) as illustrated by mounting a **DIN 35 rail**, cable glands, and any other required components. *This enclosure type should be earthed.*

If you are using the WiFi model or a cellular modem, a **Metal Enclosure** will impede your signal strength. In these cases, the antenna should be installed on the outside of the enclosure using a compatible **Antenna Extension Cable**.

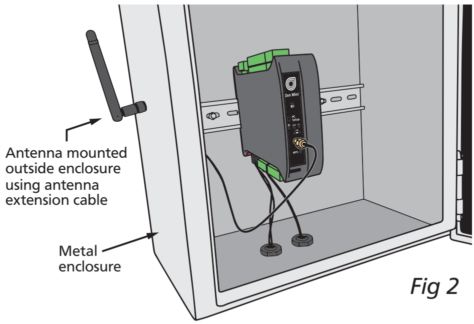


Fig 2

C - DIN Rail Mounting (Fig 3)

To clip the unit onto the DIN rail:
(**1**) Hook the upper part of the unit onto the rail, and then (**2**) Press down towards the rail until the red hook clicks into place.

Leave at least 0.79" (2cm) clear on either side of the unit, and at least 1.97" (5cm) clear above and below the unit, to allow room for airflow and wiring.

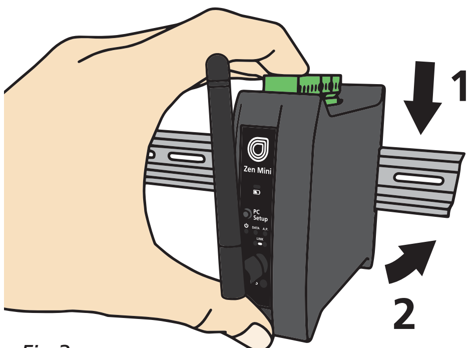


Fig 3

D - Wiring

Refer to Sections 7–8 in this manual.

E - Removal from DIN Rail (Fig 4)

To unclip the unit from the DIN rail, power the unit down and remove the power connector.

Then insert a small screwdriver into the slot on the red hook (just visible when the power connector is removed), and lever it down. This will release the hook, allowing the unit to be detached from the **DIN rail**.

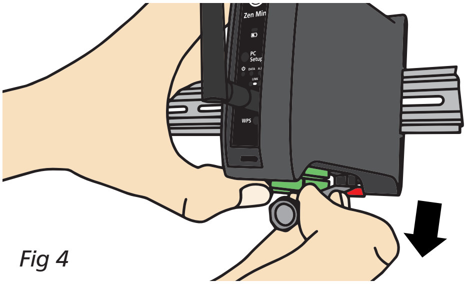


Fig 4

4.4 - EMC Installation Guidelines

The Zen IoT has been designed to cope with large EMC disturbances. This has been achieved by continual testing and improvement of filtering and layout techniques.

The Zen IoT meets CE noise requirements, and even surpasses them in many tests. (For full details and test results, see Appendix A.) However in some applications with less than optimum installations and large power switching, the EMC performance of the unit can be further improved by:

A Installing the unit in an earthed **Metal Enclosure** (as in Fig 2). This is particularly useful if the control box is mounted close to large power switching devices like contactors. Every switching cycle there is a possibility of generating a large amount of near field radiated noise. The **Metal Enclosure**, acting as a faraday cage, will shunt this radiation to ground and away from the unit.

B Increasing the physical distance from the power devices. For example, increasing the control box distance from 6" to 12" from the noise source will reduce the noise seen by the control box by a factor of 4. (Probably the cheapest and best results in this situation could be obtained by adding RC snubbers to the contactors or power switches.)

C Using shielded cable on sensitive input and control signal lines. Good results can be obtained by grounding the shields to the metal enclosure close to the entry point. All cables act as aerials and pick up unwanted R.F. radiated signals and noise; the earthed shield acts as a faraday cage around the cables, shunting the unwanted energy to ground.

Shields can also help with capacitively coupled noise typically found in circumstances when signal cable is laid on top of noisy switching power cables. Of course in this case you are better off to keep separate signal and power lines.

D Laying cable on earthed cable trays can also help reduce noise seen by the Zen IoT. This is particularly useful if there are long cable runs, or the unit is close to radiating sources such as two way radios.

E The relay outputs of the Zen IoT have built in MOV's to help reduce EMI when switching inductive loads. EMI can further be reduced at the load by adding snubbers for AC signals or a flyback diode for DC coils.

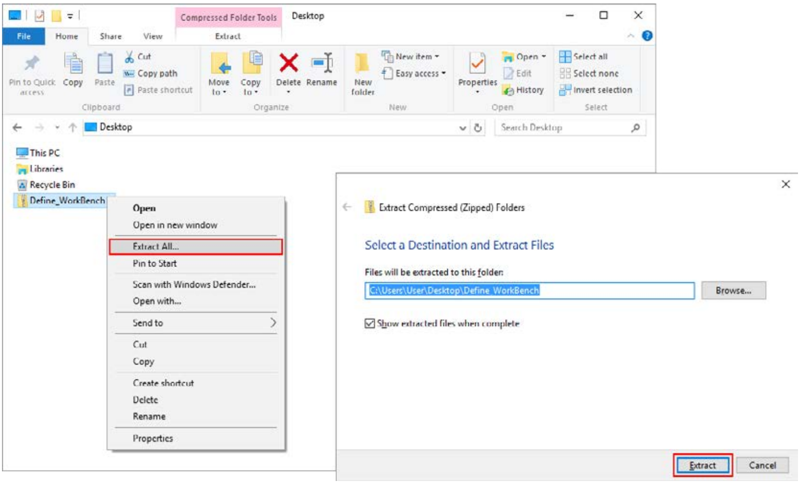
5 INSTALLING DEFINE WORKBENCH

Define WorkBench offers a comprehensive and yet simple-to-use setup tool for your Zen IoT, complete with data log extraction and visualization.

You must install WorkBench before connecting the Zen IoT to your computer. If you have already connected using the Bridge Key, **please disconnect before continuing**.

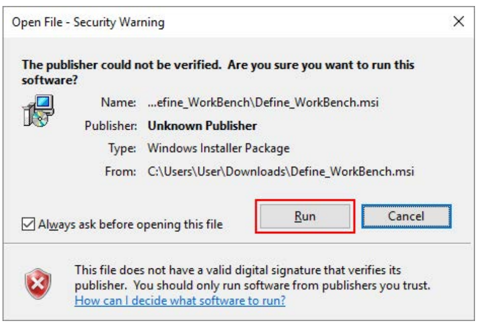
A Download the latest version of WorkBench from www.defineinstruments.com/workbench

B Extract the install file from the zip folder. Right-click on the zip folder and choose '**Extract All**', (or extract the file using another extraction utility of your choice).



C Double-click on the extracted **.msi** install file. This will launch the WorkBench installer.

Depending on your security settings, a 'Security Warning' dialog may appear. If you see the security message, click '**Run**'.

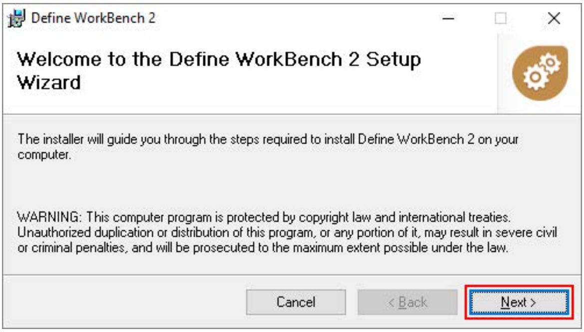


D The WorkBench setup wizard will launch.

Click '**Next**' to get started.

E The wizard will also ask for confirmation that you wish to begin the installation.

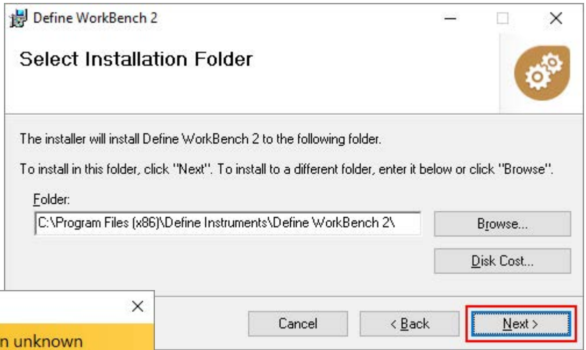
Click '**Next**' to continue.

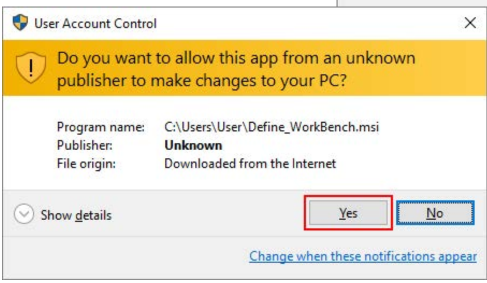


F The wizard will then prompt you to select an installation folder.

You may accept the default installation folder, or select an alternative location by clicking '**Browse**'.

Click '**Next**' to continue.





G Depending on your security settings, the 'User Account Control' dialog may appear.

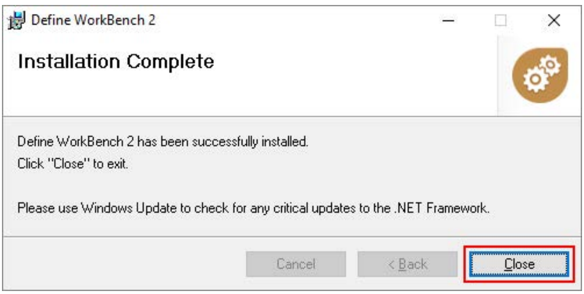
If it does, simply click '**Yes**' to allow the program to be installed on your computer.

H The install wizard will now install Define WorkBench. Please wait. This process usually takes 2–3 minutes, but may take longer in some situations.

I When the installation has successfully completed, the following dialog will appear.

Click '**Close**' to exit.

The installer will place an icon on your desktop for easy access to WorkBench.



6 SOFTWARE CONFIGURATION

6.1 - Connecting

Connect the Bridge Key

To program your Zen IoT, connect one end of the **Interface Cable** to the 'PC Setup' port on the unit's front panel, and the other end to your **Bridge Key**.

Then plug the **Bridge Key** into your computer's USB port (see Fig 5).

Supply Power

Supply power to the Zen IoT, referring to 7.1 for wiring.

Connect to your Zen IoT in Define WorkBench

Launch Define WorkBench (see Section 5 for installation instructions), and select the 'Prog Port' tab.

If your Zen IoT is powered up and connected via the Bridge Key, then the COM Port will be detected automatically. Click 'Connect'.

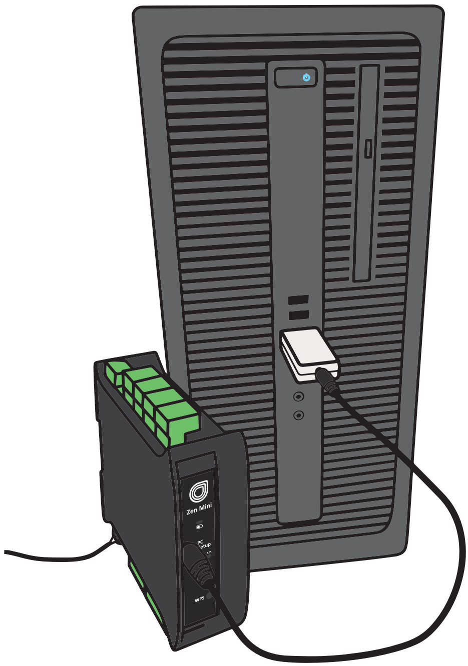
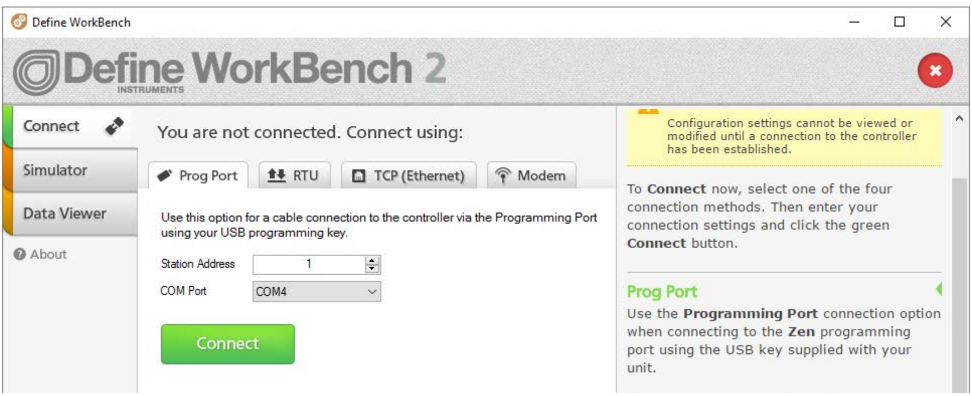


Fig 5

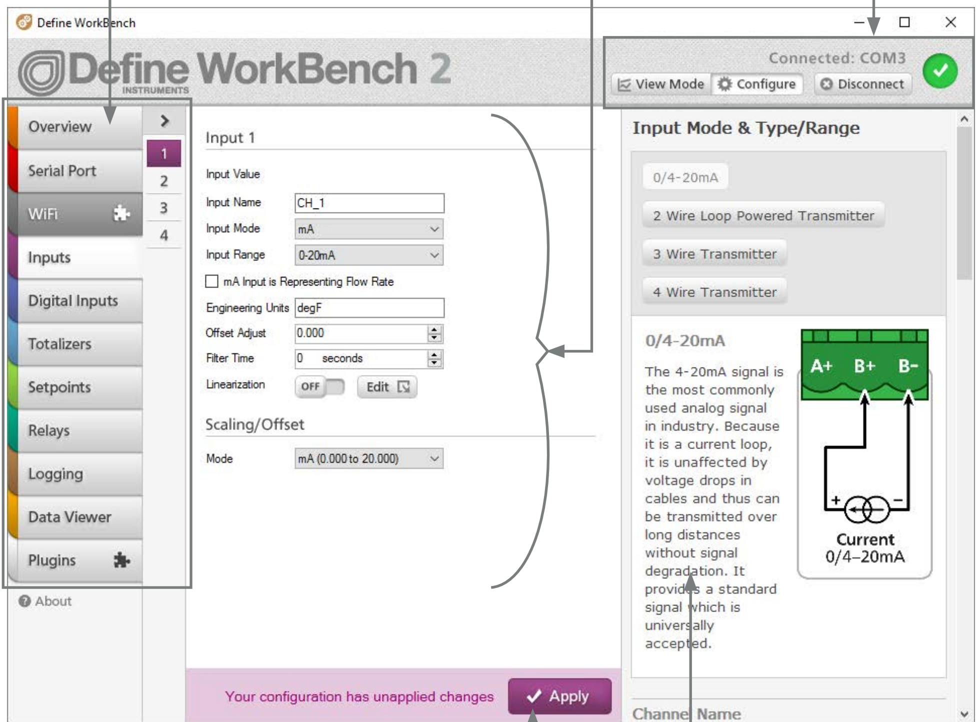


6.2 - WorkBench Interface Overview

Main Navigation, including channel sub-navigation. See 6.3 for more information.

Control Area
Main control area for configuring your system. Any changes made in this area will bring up the **Apply Button** (see below)

Connection Panel
Disconnect button
Connection status



Apply Button
Appears if you have made any changes in the **Control Area**. WorkBench will not allow you to browse to a new tab in the **Main Navigation** with unapplied changes to your configuration.

Help Panel
Wiring diagrams, explanations and helpful tips will automatically appear in this panel as you configure the unit.

6.3 - Main Navigation

Overview

View basic device information including Serial Number and firmware version. Password protect, export a configuration certificate, and save/upload configuration settings.

Serial Port

This tab is only visible if you are connected to your Zen IoT via the USB Programming Port. It enables you to configure a range of settings for the default RS232 / RS485 port.

Inputs

Set up and scale the universal isolated input channels. Includes integrated wiring diagrams and examples.

Digital Inputs

Set up the four digital inputs and view their live status.

Totalizers

Configure up to 10 totalizers using either an input channel or a digital input as the source.

Setpoints

Configure up to 16 setpoints which can be activated by an input, a digital input or a totalizer. Configure alarms or control functions by selecting from a variety of pre-programmed modes.

Relays

Configure the four relay outputs. These may be driven from one or more setpoints, or directly from one of the digital input pins.

Logging

Configure your data logging interval, set the time, and select which channels to log.

Data Viewer

View and analyze your live data and download it to your computer.

Plugins

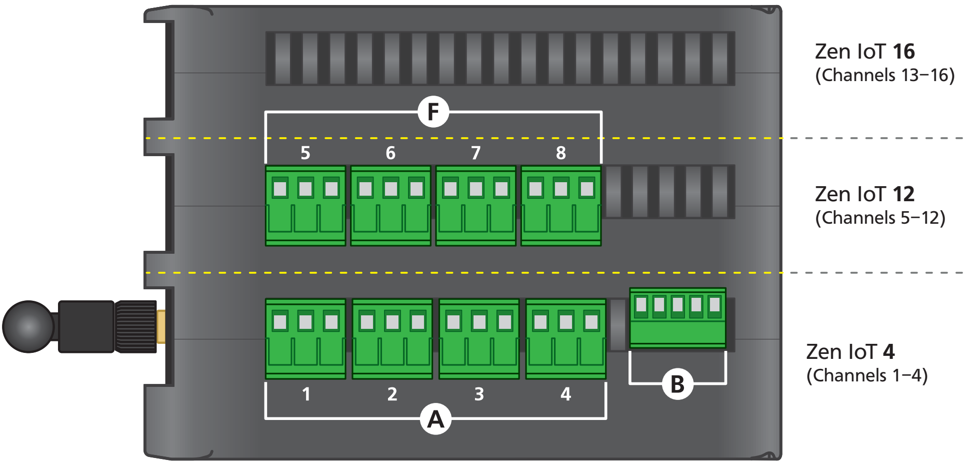
Plugins are small programs which are loaded into the Zen IoT to expand its functionality or simplify its use. Available plugins for the Zen IoT include:

- **WiFi** *(requires WiFi hardware)*
  Enables your Zen IoT to wirelessly connect to a LAN or the internet via a local WiFi network, allowing it to become a Modbus TCP server for configuration or data viewing applications, or to send regular data log updates to a variety of IoT Cloud service providers.
- **Ethernet** *(requires Ethernet hardware)*
  This plugin enables your Zen IoT to connect to a LAN or the internet via wired Ethernet connection, allowing it to become a Modbus TCP server for configuration or data viewing applications, or to send regular data log updates to a variety of IoT Coud service providers.
- **Modem** *(requires RS232 / 485 port)*
  This plugin allows your Zen IoT to be connected to a cellular modem (sold separately). It can be used to access the unit remotely, send SMS and email alerts, or to send regular data log updates to a variety of IoT Cloud service providers. Note that a 3G or 4G SIM card will be required, and cellular data charges apply.

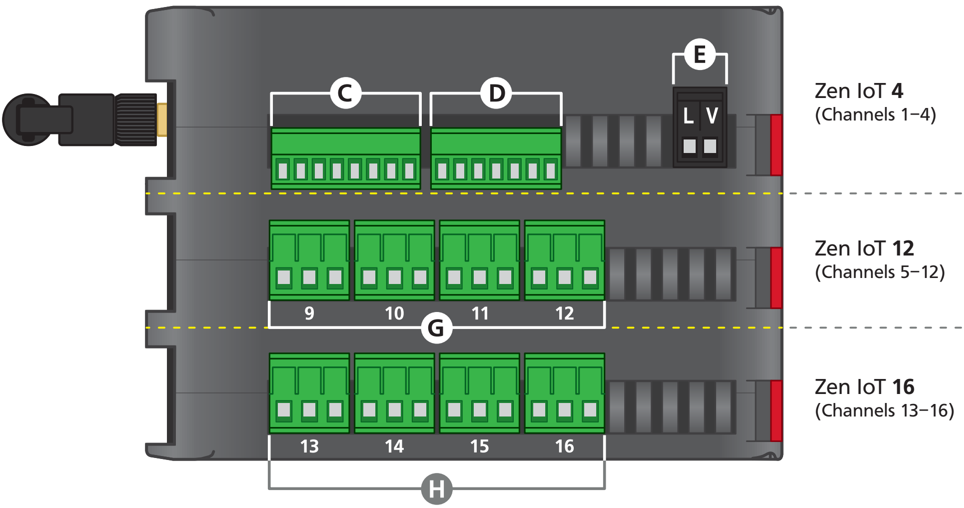
7 WIRING & LED'S

7.1 - Zen IoT Terminals

Upper Terminals



Lower Terminals



7.2 - Analog Input

See 7.1A (also 7.1F–H for Zen IoT 12/16)

The four primary analog input channels (included for all Zen IoT models) are shown in 7.1A. For Zen IoT models with expanded input channels, please also refer to 7.1F (for channels 5–8), 7.1G (for channels 9–12), and 7.1H (for channels 13–16).

All input terminals are universal and can be wired for a range of input types, as detailed in Section 8. Please also refer to the product label for input terminal pinouts.

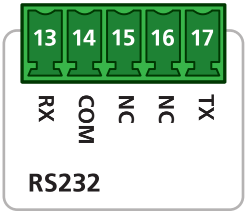
7.3 - Serial Port (RS232 / RS485)

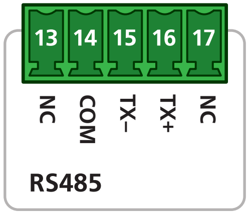
See 7.1B & 7.7C

Default RS232 / RS485 Port

Unit Top, Marked 'Serial Port' or 'Port 2'

The auto-detecting serial terminal on the top side of the unit can be wired for either RS232 or RS485, as shown.

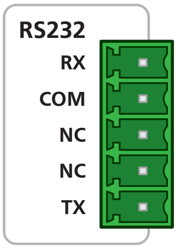


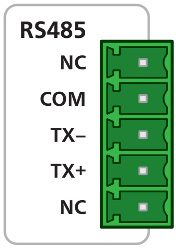


Additional RS232 / RS485 Port

Front Panel, Marked 'Port 1'

For units with an additional RS232 / RS485 serial port on the front panel (-RS model code), this can be wired as shown.



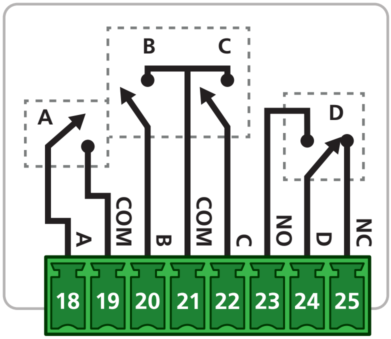


> **NOTE**
> **Pins marked 'NC' MUST be left disconnected to ensure correct auto-detection of your comm type.**

7.4 - Relay Output

See 7.1C

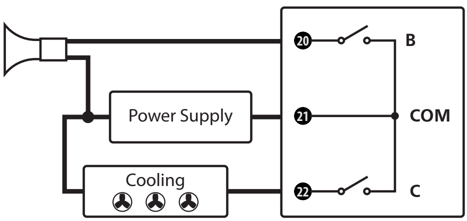
The four Relay Outputs (A–D) can be wired as shown (right) and configured in Define Work-Bench from the "**Relays**" tab.



Relays A–C are normally open solid state relays (SSR), capable of switching up to 0.4A at 30V DC. They are ideal for driving larger relays, contactors, or digital inputs of PLC's or other control devices.

Relay D is a latching Form C relay having both normally open and normally closed contacts. Being a latching type relay means that it draws zero current once energized. This is ideal for switching loads like modems on and off when running in low power mode.

Connection example for relay outputs (B & C)



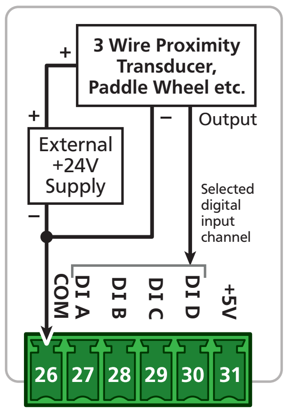
Note 1 Example uses solid state relays B and C.

Note 2 30V AC/DC, 0.4A maximum contact rating.

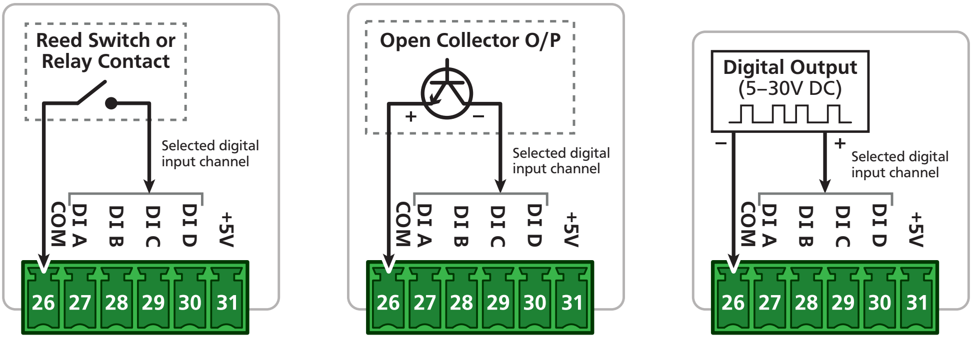
7.5 - Digital Input

See 7.1D

The Zen IoT has four Digital Inputs (A–D) which can be configured and scaled using Define WorkBench from the "**Digital Inputs**" tab, as per the list below:

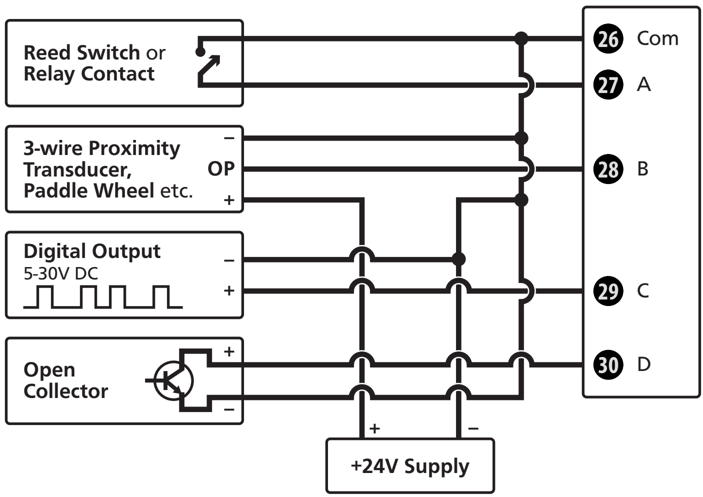


- **Status** (active/inactive - can be read by a SCADA system as a general digital input)
- **Counter** (up to 10KHz, or 100Hz Debounced)
- **Frequency** (up to 10KHz)
- **Flow count** (up to 10KHz)
- **Flow rate** (up to 10KHz)
- **RPM** (up to 10KHz)



NOTE
The Digital Inputs can be configured in software to be either Sinking (active low input) or Sourcing (active high input). The diagrams in this manual are for **Sinking** wiring, which is the default configuration. To view **Sourcing** wiring, please refer to the help information provided in Define WorkBench.

Connection example for digital inputs (A–D)



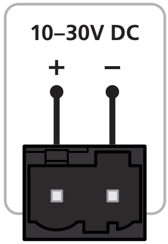
Note 1 All cables must be screened, with screen earthed at one end only.

NOTE
The universal analog inputs can also be wired as digital pulse inputs (see 8.5).

7.6 - Power Supply

See 7.1E

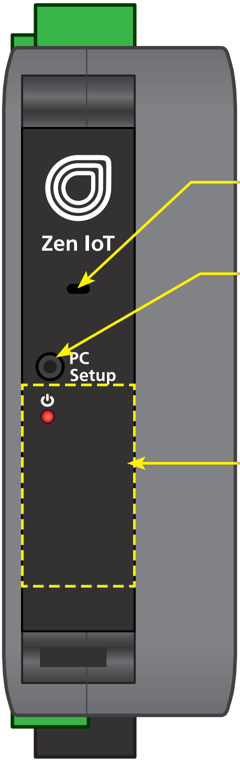
Wire your power supply for 10–30V DC supply, as shown.



> **CAUTION**
> **Low voltage (10–30V DC) only.** Higher voltages will damage the Zen IoT.

> **NOTE**
> **If the supply voltage is less than 10V at power up, the unit will go into a low power mode while waiting for the supply voltage to reach an acceptable level.**
> During this time the power LED (see 7.7) will flash very quickly every 2–3 seconds to warn you that it is waiting for the supply voltage to increase.

7.7 - Front Panel & LED's

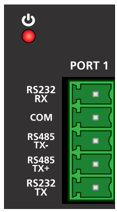


A - Battery replacement
This unit uses a CR2032 long-life battery as backup for the real-time clock. To replace the battery, insert a small screw-driver into this hole and gently bend the coverplate out-wards to lever it off. *See 10.2 (Troubleshooting) for more information about when to replace the battery.*

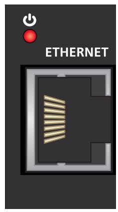
B - Programming port
See 6.1

C - Additional comm port and LED status area

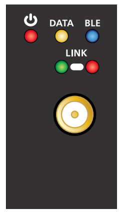
RS



EIOT



WIFI



LED	Description
	Power indicator. **Flashing between Green & Red=** Normal operation. **Red for 2–3 seconds following power up=** Unit is booting up and checking for errors. **Intermittent rapid flashing Red=** Supply voltage is too low. **Red continually=** Error (contact your distributor).
DATA	**Flashing=** Data is being transmitted, or a connection is being established.
BLE	**Rapid Flashing=** Bluetooth connected; **Slow Flashing=** Bluetooth not connected. ***Note:*** *Bluetooth is an optional OEM feature and is not installed on standard units.*
LINK	The red and green link LED's indicate the status of the wireless link. **Green Off, Red On=** Not connected (idle). **Green & Red Toggling=** Trying to connect in Station Mode. **Green & Red Flashing=** Trying to connect in Access Point Mode. **Green On, Red Off=** Station Connected. **Green On, Red On=** Access Point Connected. ***Note:*** *See 2.1 (WiFi Operating Modes) for more information on Sation Mode and Access Point Mode*

8 INPUT WIRING & SPECIFICATIONS

CAUTION
Risk of electric shock. Dangerous and lethal voltages may be present on the input terminals. Please take appropriate precautions to ensure safety.

CAUTION
Risk of danger. The sensor input can potentially float to dangerous and unexpected voltages depending on what external circuit it is connected to. Appropriate considerations must be given to the potential of the sensor input with respect to earth common.

8.1 - Current Input

Range 0–20mA, 4–20mA

Input impedance 45Ω

Maximum over-range protected by PTC to 24V DC

Accuracy 0.1% FSO max

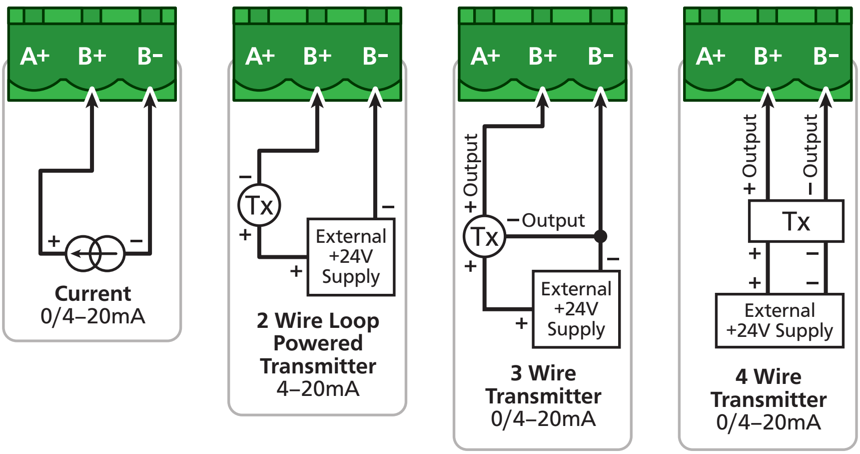
Linearity & repeatability 0.1% FSO max

Channel separation 0.001% max

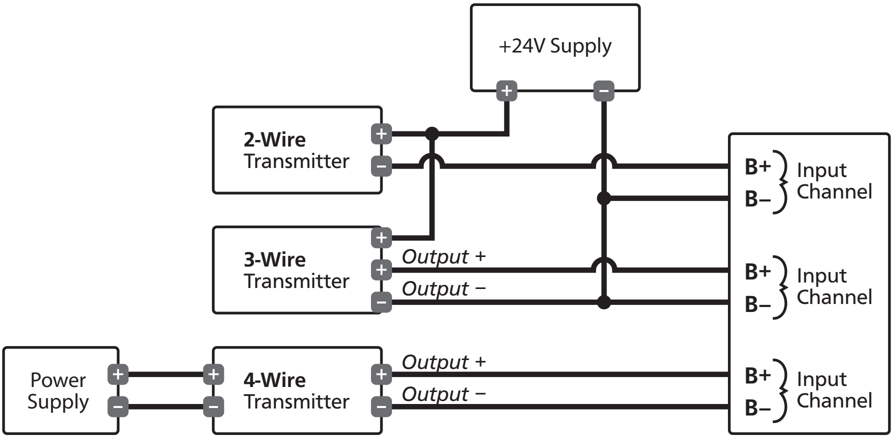
Ambient drift 0.003%/°C FSO typical

RF immunity 1% effect FSO typical

0/4–20mA DC is the most commonly used analog signal in industry, and is universally accepted. As a current loop, it is unaffected by voltage drops in cables, and can be transmitted over long distances without signal degradation.



Connection example for 2, 3 & 4 wire mA output transmitters



Note 1 All analog inputs are isolated to other channels and all other voltages. They also have built in over voltage protection to 24V, protecting the unit if the 24V supply is inadvertently connected to the unit when configured for mA input.

Note 2 All cables must be screened, with screen earthed at one end only.

Note 3 Do not run input cables in close vicinity to noisy power supplies, contactors or motor cables. The best practice is to run input cables on a separate earthed cable tray. This will minimize RFI effects, of which magnitude cannot be easily predicted.

8.2 - Voltage Input

Ranges ±200mV, −200mV to 1V, 0–10V, 0–18V

Input impedance >500KΩ on all ranges

Maximum over-voltage 24V DC

Accuracy 0.1% FSO max

Linearity & repeatability 0.1% FSO max

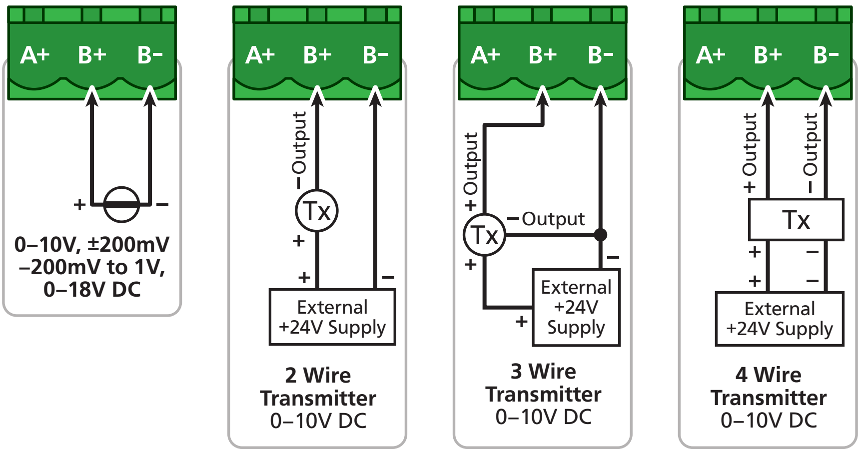
Channel separation 0.001% max

Ambient drift 0.003%/°C FSO typical

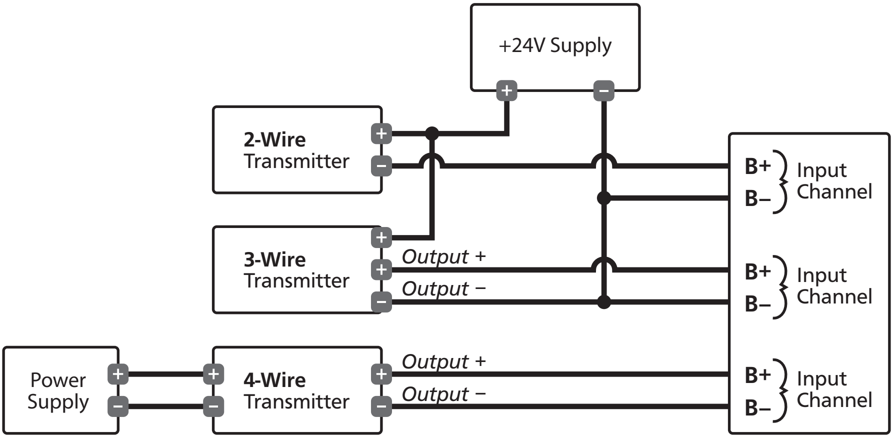
RF immunity 1% effect FSO typical

The Zen IoT accepts both voltage and millivolt inputs. Along with the standard 0–10V DC range, a variety of other ranges are provided to suit a various applications. These can all be selected using the WorkBench software and easily scaled into engineering units.

The ±200mV DC and -200mV to 1V DC ranges are ideal for low signal applications, such as measuring large DC currents using external current shunts, or interfacing to sensors with low voltage output. A 0–18V general purpose voltage range is also provided.



Connection Example for Millivolt & Voltage Inputs for 2, 3 & 4 Wire Transmitters



Note 1 Each voltage input must not see more than 18V peak between the negative and the input, otherwise permanent damage may occur.

Note 2 All cables must be screened, with screen earthed at one end only.

Note 3 Do not run input cables in close vicinity to noisy power supplies, contactors or motor cables. The best practice is to run input cables on a separate earthed cable tray. This will minimize RFI effects, of which magnitude cannot be easily predicted.

8.3 - RTD Input

RTD Pt100 3 wire RTD DIN 43760: 1980

RTD Pt1000 3 wire RTD standard

Resolution
-328–572°F (-200–300°C) = 0.02°F (0.01°C)
-328–1472°F (-200–800°C) = 0.1°F (0.1°C)

Lead resistance 10Ω/lead max recommended

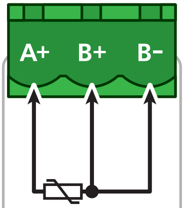
Sensor current 0.6mA continuous

Sensor fail upscale

Accuracy
-328–572°F (-200–300°C) = ±0.1°C
-328–1472°F (-200–800°C) = ±0.3°C

Ambient drift 0.003°C/°C typical

The RTD (standing for Resistance Temperature Device) is highly stable and accurate, and is fast becoming the most popular temperature sensor in industry. Often referred to as Pt100 and Pt1000, the Pt represents platinum (the dominant metal in its construction), and 100/1000 is the resistance in ohms at 0°C.

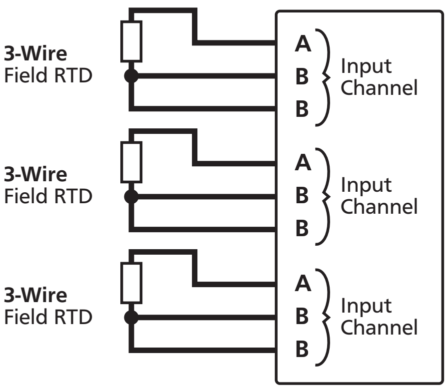


RTD 3 Wire
Pt100/1000

Supported RTD types/ranges

Pt100/Pt1000 (0.02°F/0.01°C res)	-328 to 572°F (-200 to 300°C)
Pt100/Pt1000 (0.1°F/0.1°C res)	-328 to 1472°F (-200 to 800°C)

Connection Example for 3-Wire RTD Inputs



Note 1 All RTD inputs are isolated from each other.

Note 2 All RTD cables must be screened, with screen earthed at one end only. All three wires must be the same resistance (i.e. the same type and size).

Note 3 To minimize lead resistance errors, 3-wire RTD's should be used. Offset errors for 2-wire RTD's may be compensated for in the software.

Note 4 Do not run input cables in close vicinity to noisy power supplies, contactors or motor cables. The best practice is to run input cables on a separate earthed cable tray. This will minimize RFI effects, of which magnitude cannot be easily predicted.

8.4 - Thermocouple Input

Thermocouple types B, E, J, K, N, R, S or T type (see table below for ranges)

Cold junction compensation 14 to 140°F (–10 to 60°C)

CJC drift <0.02°C/°C typical for all inputs

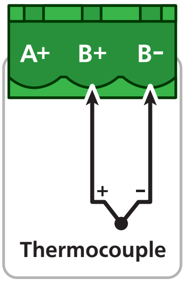
Sensor open Upscale

TC lead resistance 100Ω max

Input impedance >500KΩ

Accuracy 0.1% of FSO ±1°C typical

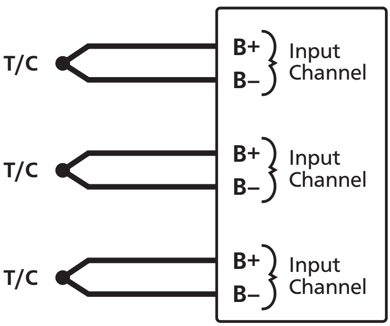
The thermocouple is one of the most common temperature sensors used in industry. It relies on the Seebeck coefficient between dissimilar metals. The thermocouple type is selected with reference to the application temperature range and environment, with J and K type being the most common.



Supported thermocouple types/ranges

B	32 to 3272°F	(0 to 1800°C)
E	-328 to 1292°F	(-200 to 700°C)
J	-328 to 1832°F	(-200 to 1000°C)
K	-328 to 2300°F	(-200 to 1260°C)
N	-328 to 2372°F	(-200 to 1300°C)
R	32 to 3092°F	(0 to 1700°C)
S	32 to 3092°F	(0 to 1700°C)
T	-328 to 752°F	(-200 to 400°C)

Connection Example for Thermocouple Inputs



Note 1 All thermocouple inputs are isolated from each other. There is no need to buy expensive isolated thermocouples.

Note 2 For accurate thermocouple measurements (especially at low temperatures) the top cover must always be fitted. Avoid drafts and temperature differences across terminals. Once installation is complete, close the cabinet door and allow the cabinet to reach equilibrium. This may take several hours. Place all thermocouple probes into a calibrated thermal bath at temperature of interest. Any offsets can be zeroed out in the software.

Note 3 All thermocouples are referenced to a combination of four CJC temperature sensors on the main Zen board. This minimizes errors caused by the mounting orientation of the Zen unit, and temperature differences in enclosures. However, for high accuracy applications it is still recommended to zero errors (see Note 2).

Note 4 All cables must be screened, with screen earthed at one end only.

Note 5 When thermocouple inputs are selected, an upscale resistor is automatically connected to the T/C + input, resulting in an overflow condition for open or broken sensors.

Note 4 Do not run input cables in close vicinity to noisy power supplies, contactors or motor cables. The best practice is to run input cables on a separate earthed cable tray. This will minimize RFI effects, of which magnitude cannot be easily predicted.

8.5 - Digital Pulse

Frequency range 0–2500.0Hz

Fast counter range 0–2500.0Hz

Sensors Open collector (NPN, PNP), TTL or Clean Contact

Frequency resolution 0.1Hz

Debounce counter range 0–50Hz max

Counter register output 32 bit

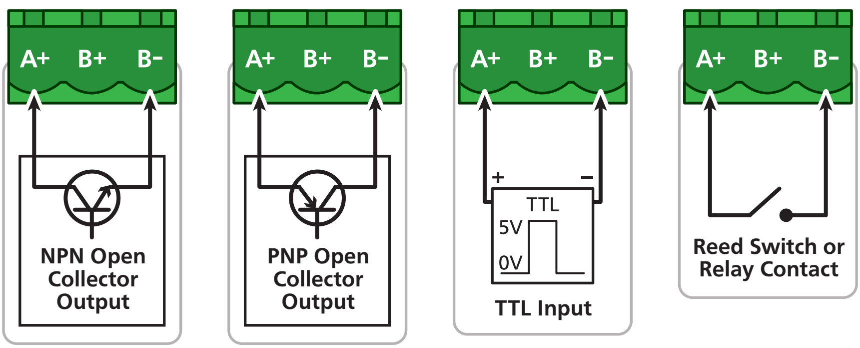
Accuracy ±0.5%

The Zen IoT's universal input terminals accept digital inputs from NPN, PNP or TTL sensors as well as Clean Contacts. Pulses up to 2.5kHz can be counted (except for the debounced counter, which has a range of 0–50Hz).

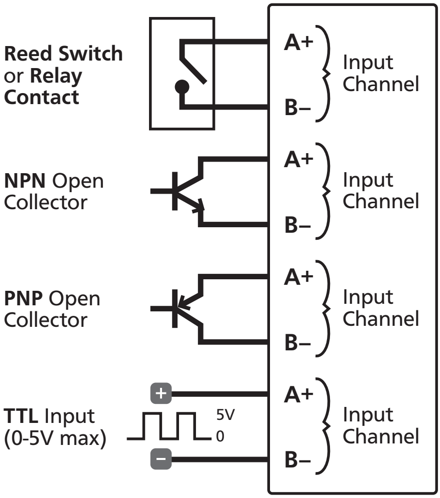
A variety of operating modes are software programmable to suit your application.

Software programmable modes include:

- General counter
- General debounced counter (ideal for mechanical relay contacts which are subject to bouncing)
- General frequency
- Flow count (uses K-factor)
- Flow rate (uses K-factor)
- RPM (uses pulses per revolution)



Connection Example for Digital Pulse Inputs



Note 1 All digital inputs are isolated from each other. Inputs from various sources can be connected without fear of crating unwanted and troublesome ground loops.

Note 2 Software selectable functions include: frequency to 2kHz, debounced counter for contact closures to 100Hz maximum, fast counter to 20KHz.

Note 3 All cables must be screened, with screen earthed at one end only.

Note 4 Do not run input cables in close vicinity to noisy power supplies, contactors or motor cables. The best practice is to run input cables on a separate earthed cable tray. This will minimize RFI effects, of which magnitude cannot be easily predicted.

8.6 - Potentiometer Input

Potentiometer input 3-wire

Excitation voltage Variable

Potentiometer resistance <2kΩ low pot; >2kΩ high pot

Field prog zero 0–90% of span

Field prog span 0.1–100%

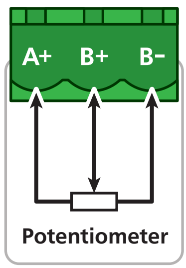
Linearity and repeatability <±0.05% FSO typical

Response time 100msec

Temperature drift <50ppm/°C

A 3 wire potentiometer is typically used to measure position. A low or high potentiometer range can be programmed to your unit using the WorkBench software.

These ranges must be calibrated using the two point calibration method.



8.7 - AC Current Sensor

Sensor type Current transformer
ACCS-420, ACCS-420-L and ACCS-010

Header selectable amperage range
ACCS-420/010 = 100/150/200A
ACCS-420-L = 10/20/50A

Output (Representing 0–100% of full scale input range)
ACCS-420(-L) = 4–20mA DC loop powered
ACCS-010 = 0–10V DC

Isolation voltage 2,000V

Power supply
ACCS-420(-L) = Loop powered, 15–36V DC
ACCS-010 = Self powered

Overload (continuous)
ACCS-420/010 = 175/300/400A respectively
ACCS-420-L = 80/120/200A respectively

Accuracy 1% of full scale

Response time 250ms (10–90%)

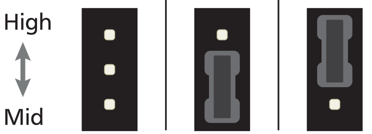
Frequency 50–60Hz

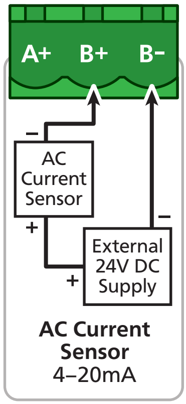
The Zen IoT accepts input from a Define Instruments AC current sensor.

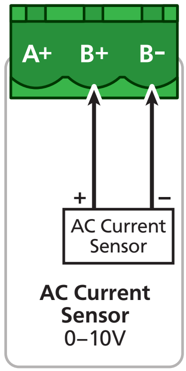
Set the jumper on the top of the current sensor to the desired current range, as shown below.

ACCS Jump Ranges

010/420:	0–100A	0–150A	0–200A
420-L:	0–10A	0–20A	0–50A







8.8 - Attenuator

Max input voltage 1000V DC

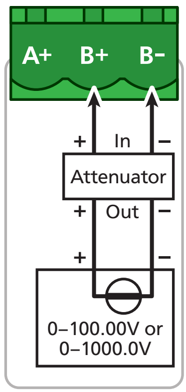
Attenuation factor 1000 ±0.1%

Input impedance 3.8MΩ

Output impedance 3.8kΩ

Attenuator type Differential resistive

Ambient drift 50ppm/°C max



This unit accepts input from a high voltage attenuator (HVA-1000). Wire the attenuator as shown.

9 CONNECTING TO A PLC

9.1 - Zen IoT Registers

Below is a list of the commonly used Zen IoT registers, displayed first in Modicon addressing format, and then as a direct address (brackets).

For a full register list, please see the **Zen IoT Registers** document, available at: defineinstruments.com/zen-iot-registers

Analog inputs 32 bit signed registers

Ch1=	40645 (644) / 40646 (645)	**Ch9=**	40661 (660) / 40662 (661)
Ch2=	40647 (646) / 40648 (647)	**Ch10=**	40663 (662) / 40664 (663)
Ch3=	40649 (648) / 40650 (649)	**Ch11=**	40665 (664) / 40666 (665)
Ch4=	40651 (650) / 40652 (651)	**Ch12=**	40667 (666) / 40668 (667)
Ch5=	40653 (652) / 40654 (653)	**Ch13=**	40669 (668) / 40670 (669)
Ch6=	40655 (654) / 40656 (655)	**Ch14=**	40671 (670) / 40672 (671)
Ch7=	40657 (656) / 40658 (657)	**Ch15=**	40673 (672) / 40674 (673)
Ch8=	40659 (658) / 40660 (659)	**Ch16=**	40675 (674) / 40676 (675)

Analog inputs 32 bit floating point

Ch1=	41193 (1192) / 41194 (1193)	**Ch9=**	41209 (1208) / 41210 (1209)
Ch2=	41195 (1194) / 41196 (1195)	**Ch10=**	41211 (1210) / 41212 (1211)
Ch3=	41197 (1196) / 41198 (1197)	**Ch11=**	41213 (1212) / 41214 (1213)
Ch4=	41199 (1198) / 41200 (1199)	**Ch12=**	41215 (1214) / 41216 (1215)
Ch5=	41201 (1200) / 41202 (1201)	**Ch13=**	41217 (1216) / 41218 (1217)
Ch6=	41203 (1202) / 41204 (1203)	**Ch14=**	41219 (1218) / 41220 (1219)
Ch7=	41205 (1204) / 41206 (1205)	**Ch15=**	41221 (1220) / 41222 (1221)
Ch8=	41207 (1206) / 41208 (1207)	**Ch16=**	41223 (1222) / 41224 (1223)

Counter/frequency inputs 32 bit signed integers

Counter1=	40525 (524) / 40526 (525)	**Counter3**=	40529 (528) / 40530 (529)
Counter2=	40527 (526) / 40528 (527)	**Counter4**=	40531 (530) / 40532 (531)

Totalizers 32 bit signed integers

Total1=	40289 (288) / 40290 (289)	**Total6**=	40299 (298) / 40300 (299)
Total2=	40291 (290) / 40292 (291)	**Total7**=	40301 (300) / 40302 (301)
Total3=	40293 (292) / 40294 (293)	**Total8**=	40303 (302) / 40304 (303)
Total4=	40295 (294) / 40296 (295)	**Total9**=	40305 (304) / 40306 (305)
Total5=	40297 (296) / 40298 (297)	**Total10**=	40307 (306) / 40308 (307)

10 MAINTENANCE

10.1 - Calibration

Your Zen IoT has been fully calibrated at the factory, and can be recalibrated in software using Define WorkBench (see Section 6). Scaling to convert the input signal to a desired display value is also done using WorkBench

If your Zen IoT appears to be behaving incorrectly or inaccurately, refer to troubleshooting before attempting to calibrate it. When recalibration is required (generally every 2 years), it should only be performed by qualified technicians using appropriate equipment.

Calibration does not change any user programmed parameters. However, it may affect the accuracy of the input signal values previously stored.

10.2 - Troubleshooting

Issue	Resolution
Auto-detecting RS Port is not working	Ensure that any terminal connections marked 'NC' are left open - otherwise the Zen IoT will not be able to auto-detect your serial type.
Power LED stays red continuously AND data log samples have inaccurate time/date	The long-life battery for the real-time clock backup needs to be replaced. Please see 7.7 for instructions.
Power LED stays red continuously	If the power LED stays red continuously but there is no problem with time/date of recent data log samples (as noted above), then the red LED indicates an internal error which will need to be assessed by the manufacturer. Please return the Zen IoT to the manufacturer for analysis and repair.
Cannot power up unit	Check the power supply connections and supply range. (The polarity on the power input is irrelevant.)
Ethernet device does not appear on the network when trying to connect in WorkBench	Repower the device after you plug in the ethernet cable to ensure that it appears on the network.

For further assistance, please contact technical support using the contact details listed at the end of this document.

A APPENDIX A - EMC TEST RESULTS

Statement of Compliance

Products in the Define Instruments 'Zen' series comply with EN 61326-1:2006.

Results Summary

The results from testing carried out in March 2014 are summarized in the following tables.

Immunity - Enclosure Ports

Phenomenon	Basic Standard	Test Value	Performance Criteria
EM Field	IEC 61000-4-3	10Vm (80MHz to 1GHz) 3V/m (1.4–2.7GHz)	Meets Criterion A
Electrostatic Discharge (ESD)	IEC 61000-4-2	4kV/8kV contact/air	Meets Criterion A (Note 1) Meets NAMUR NE 21 recommendation

Immunity - Signal Ports

Phenomenon	Basic Standard	Test Value	Performance Criteria
Conducted RF	IEC 61000-4-6	3V (150kHz to 80MHz)	Meets Criterion A
Burst	IEC 61000-4-4	1kV (5/50ns, 5kHz) 1kV (5/50ns, 100kHz)	Meets Criterion A (Note 1) Meets NAMUR NE 21 recommendation
Surge	IEC 61000-4-5	1kV L-E	Meets Criterion A (Note 1)

Immunity - AC Power

Phenomenon	Basic Standard	Test Value	Performance Criteria
Conducted RF	IEC 61000-4-6	3V(150Khz to 80Mhz)	Meets Criterion A
Burst	IEC 61000-4-4	2kV (5/50ns, 5kHz) L-N 1kV (5/50ns, 5kHz) L-L	Meets Criterion A Meets Criterion A
Surge	IEC 61000-4-5	2kV L-E 1KV L-L	Meets Criterion A Meets Criterion A (Note 1)
Voltage Dips	IEC 61000-4-11	0% during 1 cycle 40% during 10/12 cycles 70% during 25/30 cycles	Meets Criterion A Meets Criterion A Meets Criterion A
Short Interruptions	IEC 61000-4-11	0% during 250/300 cycles	Meets Criterion A (Note 1)

Performance Criteria

Performance Criterion A
During the test, normal performance within the specification limits.

Performance Criterion B
During testing, temporary degradation, or loss of performance or function which is self-recovering.

Performance Criterion C
During testing, temporary degradation, or loss of function or performance which requires operator intervention or system reset occurs.

*Note 1: EN61326-1 calls for a Criterion B pass; unit exceeds this by meeting Criterion A.

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