Zen IoT

Edge Processing Interface

Modular Industrial IoT interface hardware solution

Designed for industrial IoT monitoring applications where reliability, rapid development and deployment are demanded, the Zen IoT hardware and monitoring solution delivers robust end to end field measurement to cloud service integration.

- **Industrially hardened design and direct process interface design**
- **IoT edge processor with real-time OS**
- **Embedded input conditioning and control functions including signal processing filters and alarms**
- **Up to 22 measurement inputs, 8 analog outputs and up to 40 digital IO (including up to 7 relays)**
- **Low power optimized design**

Easily integrates with your existing automation system

The Zen IoT natively supports MQTT IoT communications protocol. ModBus RTU master/slave interface port provides direct connection to metering and control automation.

Field process signals direct to wireless interface

Zen IoT converts, conditions and processes analog signals directly to wireless WiFi (801.11) or (eMTC) LTE Cat-M1. No additional wireless modem required.

Extra cloud interface security and Store and Forward data integrity

As connection and data security are paramount, the Zen IoT provides peace of mind with Transport Layer Security (TLS) protocol. During network communications failure the Zen IoT Store and Forward function locally buffers data, forwarding to the cloud server when network communications are reinstated, securely monitoring and recording with total data integrity.

Key features:

- Define Cloud Services (DCS) connection
- MQTT with (TLS 1.2)
- Data record store and forward buffer
- RTC record data time stamp at origin
- Application logic and math functions
- PC configuration tools, USB interface
- Wireless WiFi (801.11) or (eMTC) LTE Cat-M1
- Up to 22 analog inputs
- Up to 40 digital input/outputs
- 8 Isolated process outputs (4-20mA)
- Up to 7 Relay outputs
- RS485 ModBus RTU master/slave interface
- Local display (RS232C) interface port
- AC mains and 24V low power operation

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	ZEN6	Edge Processing Interface
Base configuration: MQTT cloud service interface – TLS security layer, store and forward record buffer, RTC data time stamp, 4x isolated universal inputs (TC/RTD/V/mA/Ratio), 2x non-isolated process (4-20mA) inputs.		
Power supply	HV LV	High voltage: 85-265 AC/DC power supply Low voltage: 10-32 V DC power supply
Wireless comms	WIFI CM1	WiFi (801.11) Cellular modem (eMTC) LTE Cat-M1
Additional Analog IO	UI4 UI8 UI12 PI16 UI6E4 PI8E8	4x Universal input (isolated) 8x Universal input (isolated) 12x Universal input (isolated) 16x Process (4-20mA) input (non-isolated) 6x Universal input (isolated), 4x process (4-20mA) output (isolated) 8x Process (4-20mA) input (non-isolated), 8x process (4-20mA) output (isolated)

Required Accessories

Bridge Key	**BRIDGE-KEY**	USB Bridge Key, required for PC programming using our free WorkBench software

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:

WiFi (801.11)

Enables LOS transmission up to 1500ft (450m) using the supplied 3dBi wireless antenna.

(eMTC) LTE Cat-M1

4G cellular interface for Internet of Things (IoT) and machine-to-machine (M2M) communications.

The Zen IoT is preconfigured to connect to Define Cloud Services (DCS). Custom connection is available to third party IoT servers. Cloud communication is secured using TLS and uses MQTT IoT service transfer protocol. JSON packets contain SenML (Sensor mark-up language) data.

Simple setup with Define WorkBench software

Define WorkBench configures the Zen IoT for analog and digital inputs, alarms, totalizers and counters, custom scaling for input linearization and scale setup. The cloud interface module configures data transfer to a cloud server.

2 OPERATING MODES

2.1 - WiFi Operating Modes

Station Mode

The most common operating mode for a WiFi enabled Zen IoT 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 (see Section 6), 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.

3 SPECIFICATIONS

Power

Power supply 85–265V AC/DC (HV)
10–32V DV (LV)

Power consumption 10W max, 6W typical

Excitation output

24V DC @ 200mA maximum. Total on all +24V output pins

Data Logging

31,774 samples with up to 30 parameters plus time stamp per sample. 32 Mb capacity

Available with Real-Time Clock (RTC) option

RTC time base UTC

Local time in device with automatic daylight savings adjustment

Analog input

2x (4–20mA) process input

Input resolution 12 bits

Accuracy <±1.0% FSO (unless otherwise stated in input specifications)

Input isolation Not isolated to power supply or digital inputs

General specifications

Linearity & repeatability <±0.1% FSO

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

Relay output

1 x Change over Form C Relay (15A 250V AC or 15A 30V DC)

2 x Form A Relays 3A (3A 250V AC or 3A 30V DC)

Logic output

1 x Logic output Open collector (80mA maximum capacity)

Digital input

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, PNP, Clean Contact, Voltage 2–30V DC

Threshold 1.65V typical

Debounce counter range 0–100Hz

Isolation Not isolated to power supply or analog inputs

Comms

Protocols Modbus RTU, RS485 or Define ASCII, EIA485 compliant

Default comm port RS485. Selectable baud rate 2400–230400 baud. Format 8 bit, no parity, 1 stop bit

Functional isolation 1,500VDC (1 min) Electrical isolation 42VAC/DC (continous)

RS232 display port meets TIA/EIA232-F and ITU v28 standards

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

Wireless comms interface

WiFi (801.11)

Cellular modem (eMTC) LTE Cat-M1 Regions NZ, E1 and AU

TLS security protocol

Transport Layer Security (TLS) V1.2 with server certificate and X.509 client certificate authentication

Over Air Updates

Over The Air updates are available for main plugins, custom macros, certificates, cloud adapter firmware updates (WiFi and cellular)

MQTT interface

Based on MQTT 3.1.1 with Qos 0 & 1

Construction

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

Phoenix type removable screw terminal connectors

Dimensions (H x W x D)

Zen6 base model
3.98 x 1.73 x 4.72" (101 x 48 x 120mm)*

Zen6 with analog expansion
3.98 x 2.87 x 4.72" (101 x 73 x 120mm)*

Zen6 with analog and digital expansion
3.98 x 3.86 x 4.72" (101 x 98 x 120mm)*

*Excludes antenna and connectors

Required mounting height with antenna
4.65" (118mm), WiFi model only

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

Compliance approvals

EN61326-1:2006

EMC: EN61326-1: 2006 Class A

EN61326-1: 2006 Industrial Locations

EN50581: 2012 RoHS

Safety: EN61010, 1:2010, CuL (file listing pending)

Input

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

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

Input resolution 16 bits

Accurate to <±0.1% FSO

Thermocouple input

Thermocouple types
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)

Input impedance >500KΩ

T/C lead resistance 100Ω max

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

CJC drift <0.02°c

Accuracy 0.1% of FSO ±1°C typical

Sensor open Upscale

RTD Input

RTD input type Pt100 3 wire RTD DIN 43760: 1980 RTD Pt1000 3 wire RTD standard

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

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

Current Input

Range 0–20mA, 4–20mA

Input impedance 45Ω

Max over-range Protected by PTC to 24V DC

Linearity & repeatability 0.1% FSO max

Accuracy 0.1% FSO max

Channel separation 0.001% max

Ambient drift 0.003%/°C FSO typical

RF immunity 1% effect FSO typical

Voltage Input

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

Input impedance >500KΩ on all ranges

Maximum over voltage 24V DC

Linearity & repeatability 0.1% FSO max

Accuracy 0.1% FSO max

Channel separation 0.001% max

Ambient drift 0.003%/°C FSO typical

RF immunity 1% effect FSO typical

Potentiometer input

Potentiometer input 3-wire

Excitation voltage Variable

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

Field programmable zero 0–90% of span

Field programmable span 0.1–100%

Linearity & repeatability <±0.05% fso

Response time 100msec

Ambient drift <50ppm

Digital Pulse Input

Frequency range 0–2500.0Hz

Fast counter range 0–2500.0Hz

Frequency resolution 0.1Hz

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

Debounce counter range 0–50Hz max

Counter register output 32 bit

Accuracy ±0.5%

Analog Output

Analog output type Loop powered, isolated 4–20mA or 20–4mA DC

Isolation Isolated to Digital IO GND

Isolation test voltage 1400Vrms for 1min. Working voltage 125V DC

Resolution 15 bits, 16000 steps

Loop drop 10V max

Linearity & repeatability 0.1% FSO max

Accuracy 0.1% FSO max

Digital I/O Expansion (optional)

4 x Form A Relays 3A (3A 250V AC or 3A 30V DC)

16 x Bipolar digital inputs 24V compatible. Up to 2.5KV RMS isolation. Inputs are separated into 2 isolated groups of 8 channels

12 x Digital open collector outputs. Outputs are separated into 2 groups of 6. 0.5A max on each group. Non isolated.

Non-isolated Process input

Range 0–20mA, 4–20mA

Input impedance 45Ω

Max over-range Protected by PTC to 24V DC

Linearity & repeatability 0.1% FSO max

Isolation - none to other process inputs, 2500V AC 1 minute to all other input/output

Ambient drift 0.003%/°C FSO typical

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) with Line Of Sight.

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.

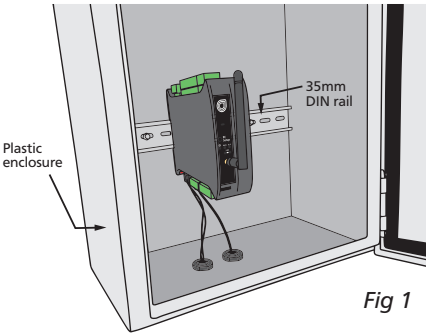


Fig 1

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**. N.B. exterior mounting is only suitable for indoor/covered outdoor environments where antenna is protected from rain or wet conditions

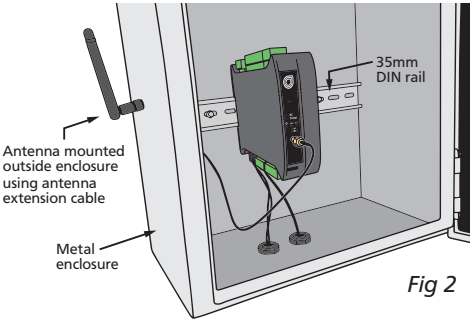


Fig 2

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 unit, and at least 1.97" (5cm) above and below, as space for airflow and wiring.

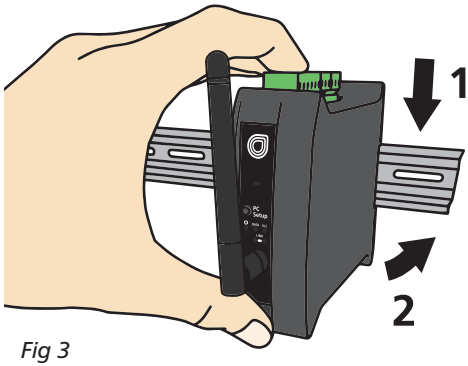


Fig 3

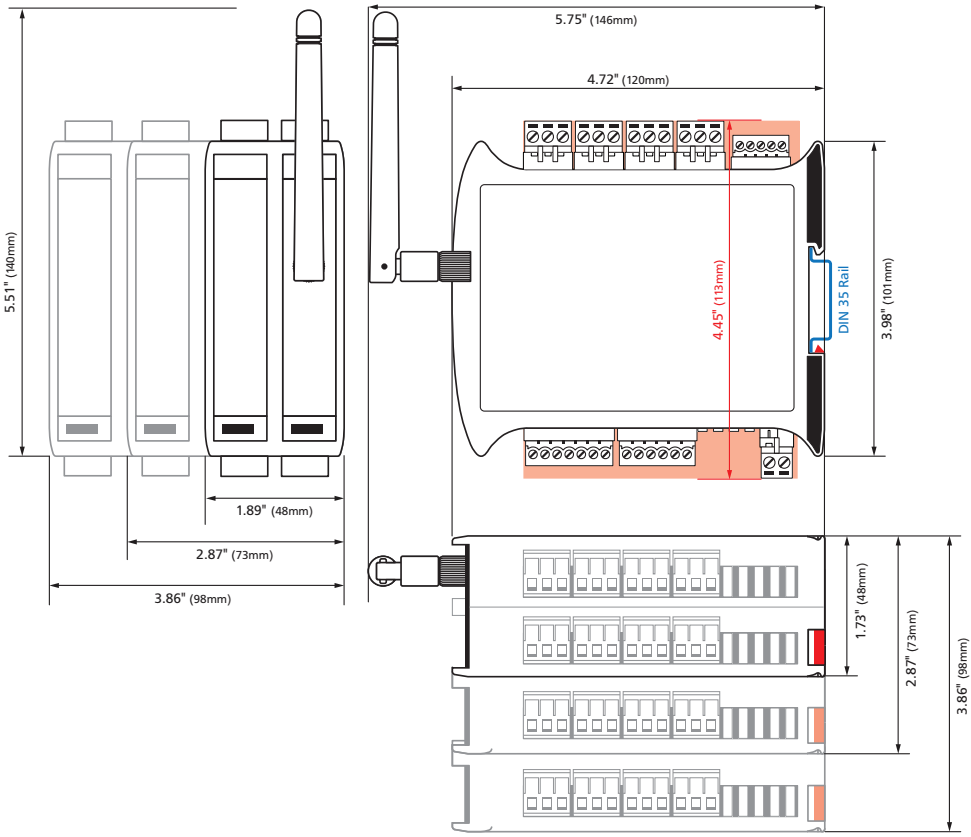
D - Wiring

Refer to Sections 7–8 in this manual.

⚠ NB: SUPPLIED WIFI ANTENNA IS NOT SUITABLE FOR OUTDOOR OR WET ENVIRONMENTS

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.**

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**.

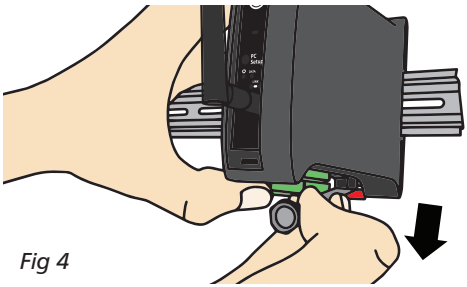


Fig 4

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 Relay A's outputs 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.

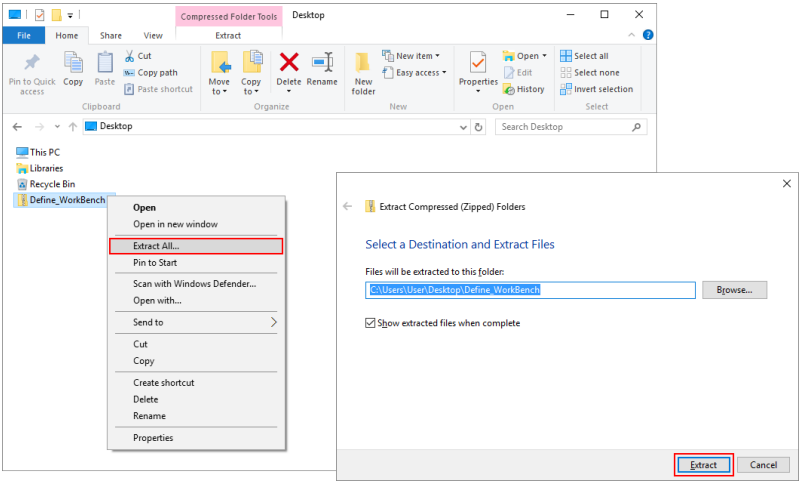
5 INSTALLING DEFINE WORKBENCH

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**.

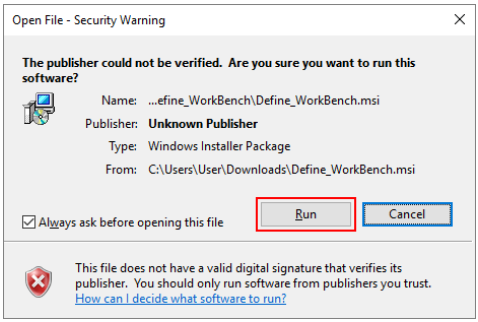
A Download the latest version of WorkBench from www.defineinstruments.com/workbench

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).



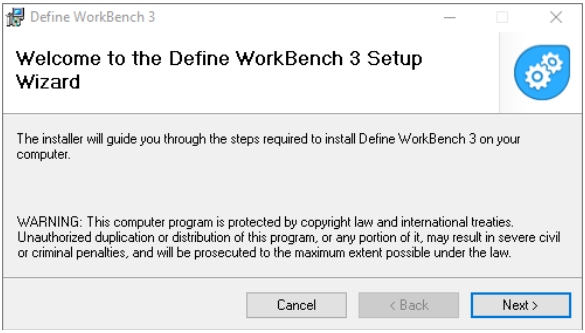
C Double-click on the extracted **.msi** install file. This will launch the WorkBench installer.

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.



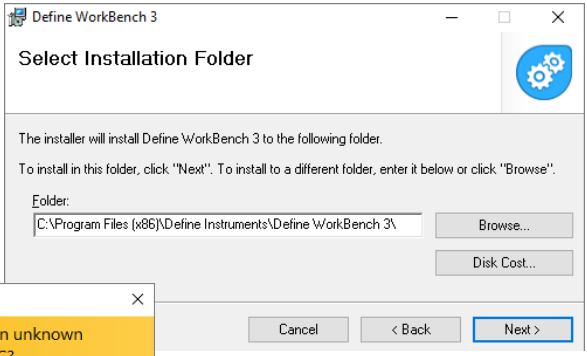
E The wizard will also ask for confirmation that you wish to begin the installation.

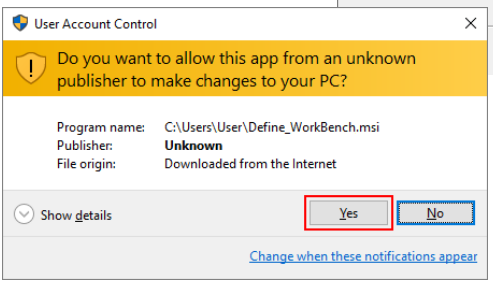
Click '**Next**' to continue.

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.

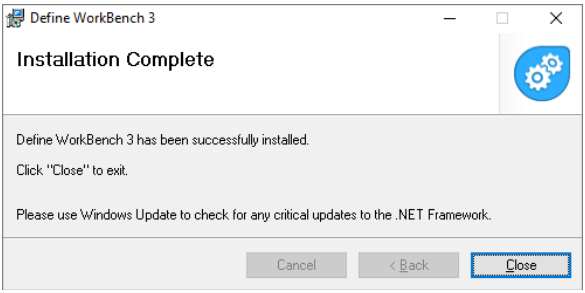
If it does, simply click '**Yes**' to allow the program to be installed on your computer.

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 (sold spearately)**.

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

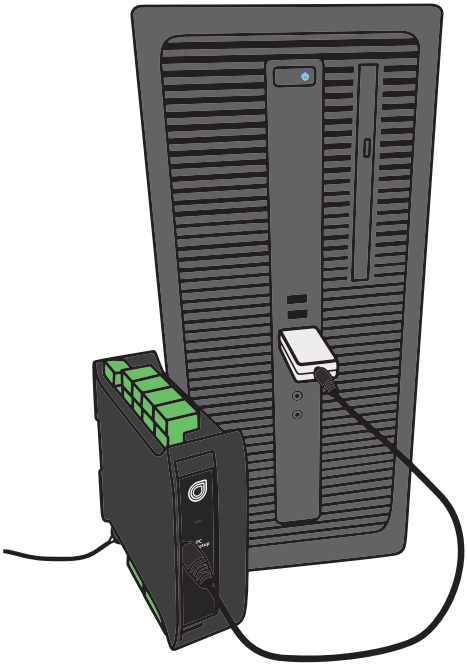


Fig 5

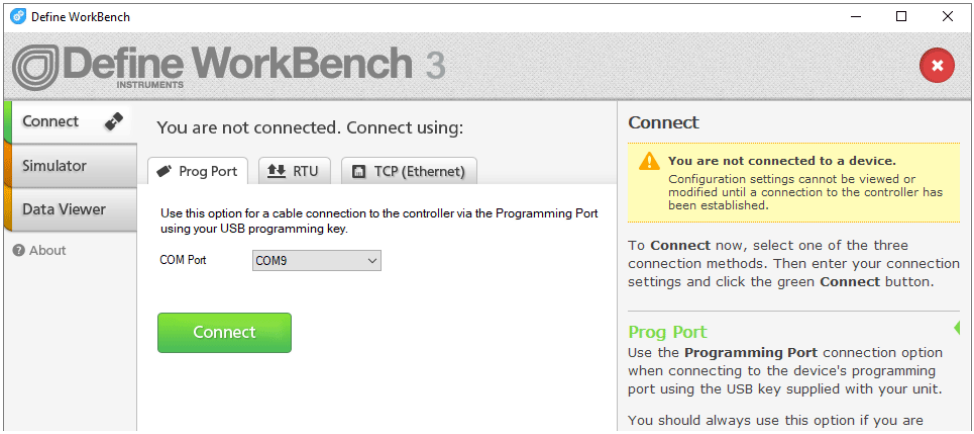
Supply Power

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'.

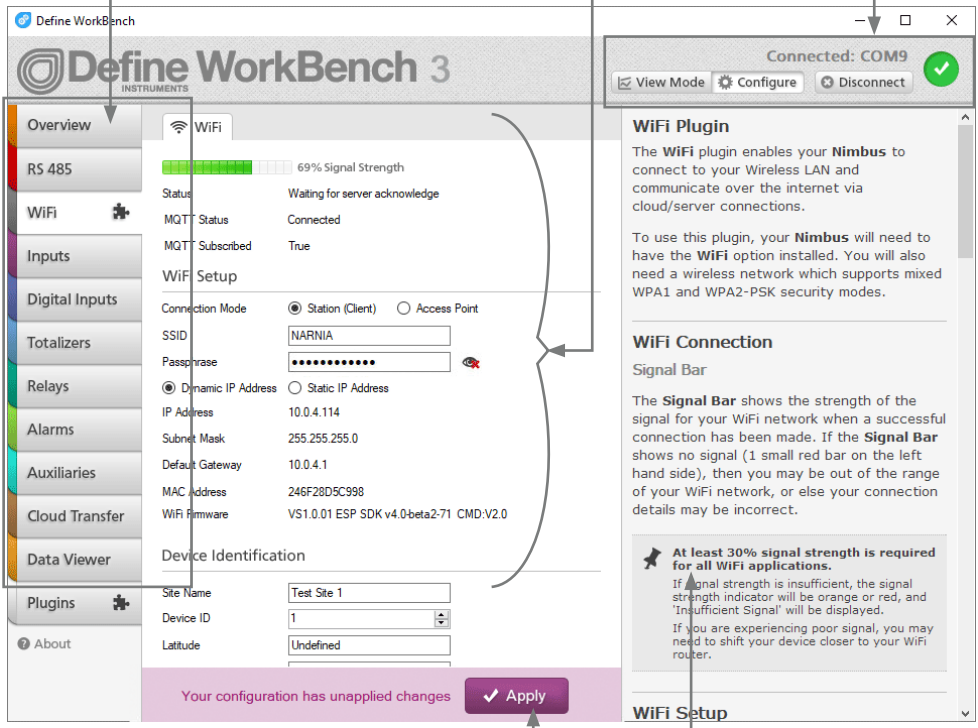


6.2 - WorkBench Interface Overview

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.

RS485

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 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.

Alarms

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

Cloud Transfer

Configure your data logging interval, set the time, and select which channels are sent to the Cloud.

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:

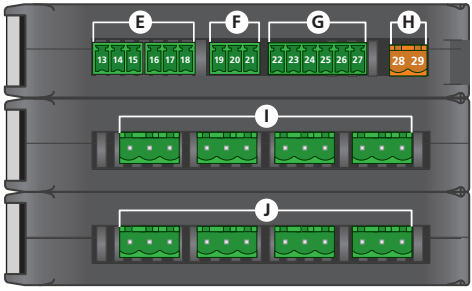
- **WiFi** *(requires WiFi hardware)*
  Enables your Zen IoT to wirelessly connect to a LAN or the internet via a local WiFi network, allowing it to become a Modbus TCP server for configuration or data viewing applications, or to send regular data log updates to a variety of IoT Cloud service providers.
- **Cellular** modem *(requires Cellular hardware)*
  Enables your Zen IoT to wirelessly connect to the internet via a cellular network, allowing it to send regular data log updates to a variety of IoT Cloud service providers. (Note: CAT-M1 is the preferred option if available in your area)

For full details on setup for both WiFi and Cellular units see:

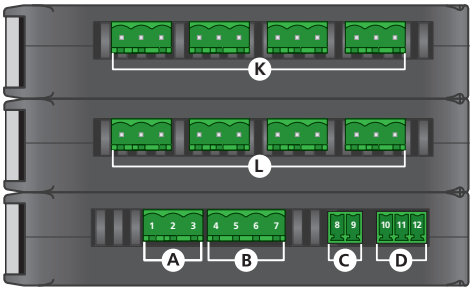
www.defineinstruments.com/videos/connecting-to-define-cloud-services-dcs

7 WIRING & LED'S

7.1 - Connectors – main processor



Color Label Facing Down



Color Label Facing Up

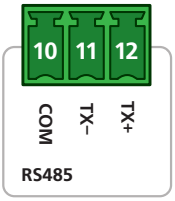
(A & B)	Relay outputs	(H)	Power supply (HV shown)
(C)	Logic output open collector	(I)	Universal analog inputs
(D)	RS485 Port	(J & K)	Additional Universal analog inputs *(UI8 and UI12 models only)*
(E)	Analog (4-20mA) inputs		
(F)	R232 Display Port	(L)	Universal analog inputs
(G)	Digital inputs		

7.2 - Serial Port RS485 (D) and RS232 (F)

RS485 Port

Unit Top

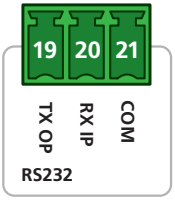
The serial terminal on the top side of the unit can be wired for RS485 as shown.



R232 Display Port

Unit Bottom

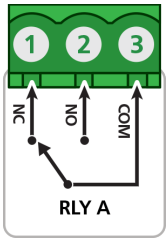
The serial terminal on the bottom side of the unit can be wired for RS232 as shown.

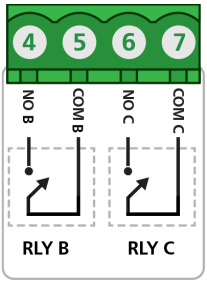


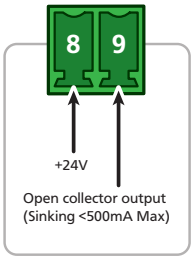
7.3 - Relay Output (A & B) and logic output collector (C)

See 7.1A & 7.1B

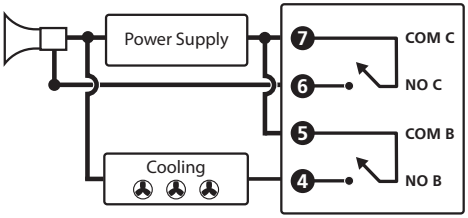
Relays A (15A 250V AC or 15A 30V DC) and B & C (3A 250V AC or 3A 30V DC) should be wired as shown.







Connection example for relay outputs (A & B)



Note 1 Example uses relays B and C.

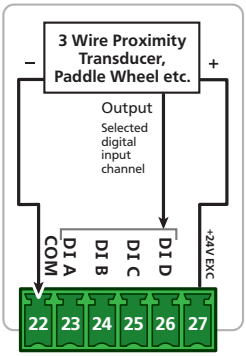
Note 2 3A (Form A) relays at 250V AC

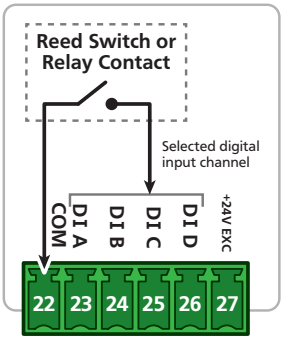
7.4 - Digital Input (G)

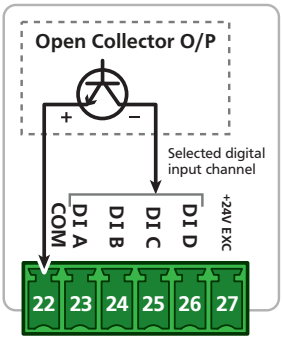
See 7.1G

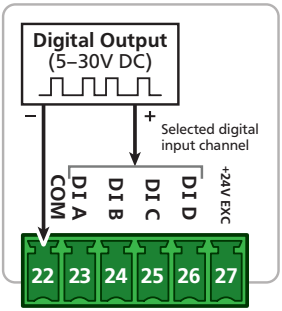
The Zen IoT has four Digital Inputs (A–D) which can be configured and scaled using Define WorkBench from the "**Digital Inputs**" tab, as per the list below:

- **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)





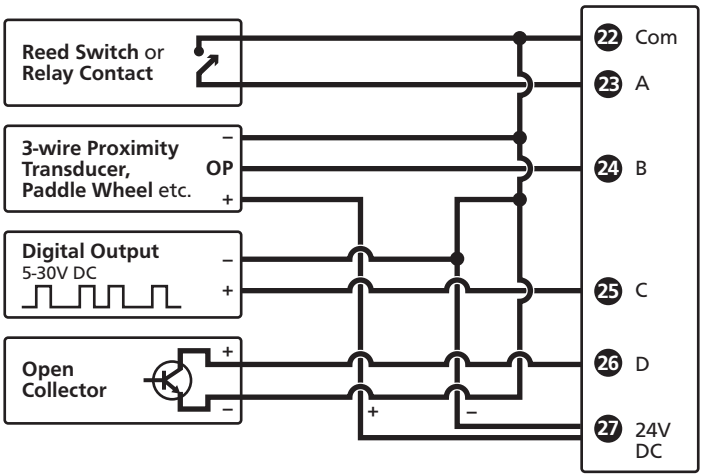




NOTE

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) using excitation from Zen IoT

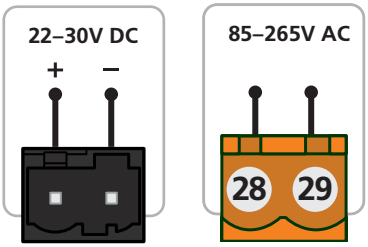


Note 1 All cables must be screened, with screen earthed at one end only.

7.5 - Power Supply

See 7.1H

Wiring for power supply for 24V DC (LV model) shown at left and 85–265V AC (HV model) shown right.

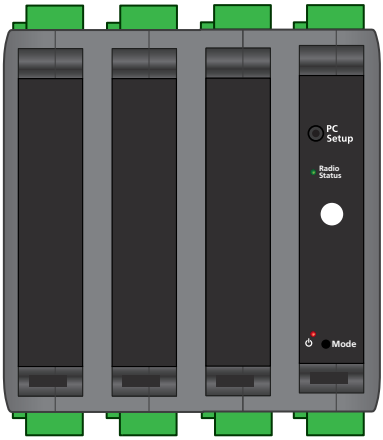


7.6 - Expansion

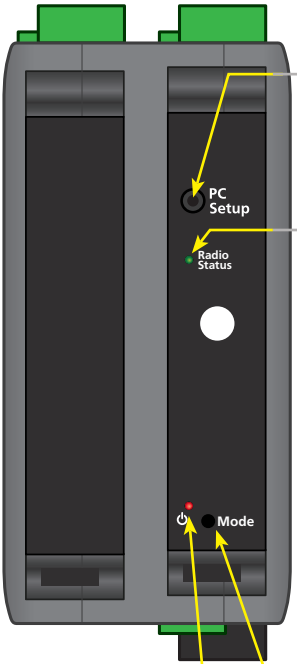
Zen6 base model

Zen6 with analog expansion

Zen6 with analog and digital IO expansion



7.7 - Front Panel & LED's



A - Programming port
See 6.1

B - Radio status LED (CAT-M1 model)

The Radio status LED indicates the status of the cellular radio link.

Off < 20 sec. after power on = normal
Off continuously = problem with the cellular radio.
Red Flashing = no SIM inserted or problem with the SIM card.
Red = waiting for signal from cellular network.
Orange = connected to cellular network, connecting to cloud.
Green = fully connected cloud.

Radio status LED (WiFi model)

The Radio status LED indicates the status of the wireless link.

Green Off, Red On= Not connected (idle).
Green & Red Toggling= Scanning for networks.
Orange Flashing= Trying to connect in Access Point Mode.
Green On, Red Off= Station Connected.
Orange On= Access Point Connected.
Green flashing= Connected to WiFi, waiting for IP.

***Note**: See 2.1 (WiFi Operating Modes) for more information on Sation Mode and Access Point Mode*

C - Status LED

Power indicator.
Flashing Green= Normal operation.
Red for 2–3 seconds following power up= Unit is booting up and checking for errors.
2x orange flashes every 2-3 seconds= firmware update in progress. This could take up to 5 minutes. DO NOT TURN THE UNIT OFF UNTIL STATUS RETURNS TO FLASHING GREEN.
Intermittent rapid flashing Red= Supply voltage is too low.
Red continually= Error (contact your distributor).
Flashes orange every 2-3 seconds= Clock battery needs replacing (contact your distributor)
Flashes orange multiple times = non critical error (contact your distributor).

D - Mode button (WiFi model only)

Press this button for <2 seconds to toggle between **Station Mode** and **Access Point** (AP) mode. Press and hold until the Radio status LED turns:

- **Green** to change to Station mode.
- **Orange** to change to Access Point mode.
- **Red** to set WPS 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 150Ω

Maximum over-range protected by PTC to 24V DC

Accuracy 0.1% FSO max

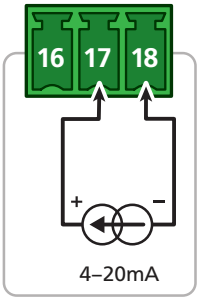
Linearity & repeatability 0.1% FSO max

Channel separation 0.001% max

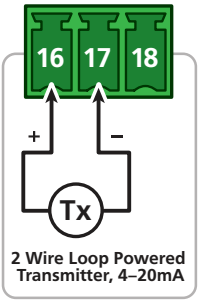
Ambient drift 0.003%/°C FSO typical

RF immunity 1% effect FSO typical

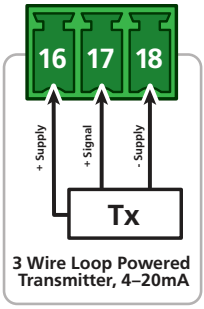
0/4–20mA DC is the most commonly used analog signal in industry, and is universally accepted. As a current loop, it is unaffected by voltage drops in cables, and can be transmitted over long distances without signal degradation.



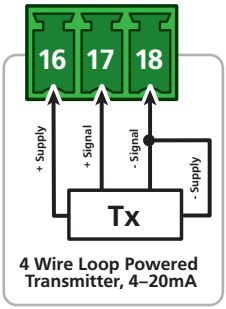
4–20mA



2 Wire Loop Powered Transmitter, 4–20mA



3 Wire Loop Powered Transmitter, 4–20mA



4 Wire Loop Powered Transmitter, 4–20mA

8.2 - AC Current Sensor (sold separately – order codes: ACCS-420, ACCS-010)

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

Header selectable amperage range
ACCS-420 = 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

Isolation voltage 2,000V

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

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

Accuracy 1% of full scale

Response time 250ms (10–90%)

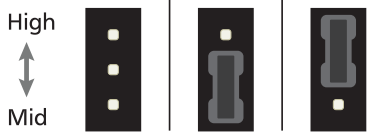
Frequency 50–60Hz

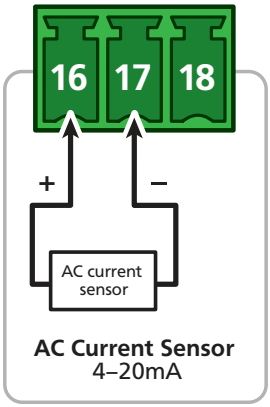
The Zen IoT accepts input from a Define Instruments AC current sensor.

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





8.3 - 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

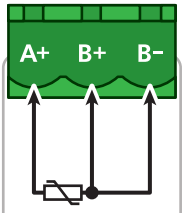
Sensor current 0.6mA continuous

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.

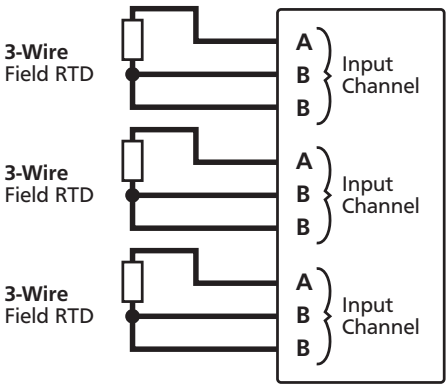


RTD 3 Wire
Pt100/1000

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

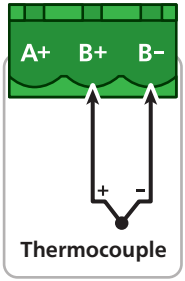
Sensor open Upscale

TC lead resistance 100Ω max

Input impedance >500KΩ

Accuracy 0.1% of FSO ±1°C typical

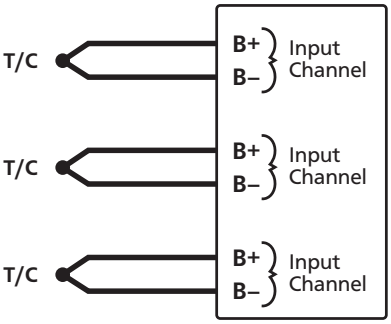
The thermocouple is one of the most common temperature sensors used in industry. It relies on the Seebeck coefficient between dissimilar metals. The thermocouple type is selected with reference to the application temperature range and environment, with J and K type being the most common.



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 (alternate operating mode of analog universal inputs)

Frequency range 0–2500.0Hz

Frequency resolution 0.1Hz

Fast counter range 0–2500.0Hz

Debounce counter range 0–50Hz max

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

Counter register output 32 bit

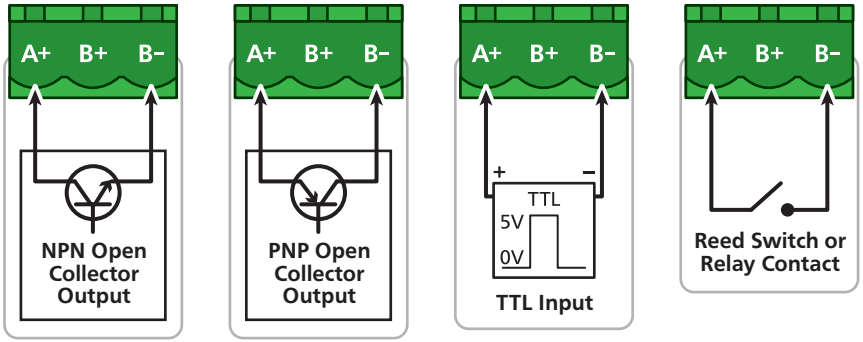
Accuracy ±0.5%

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).

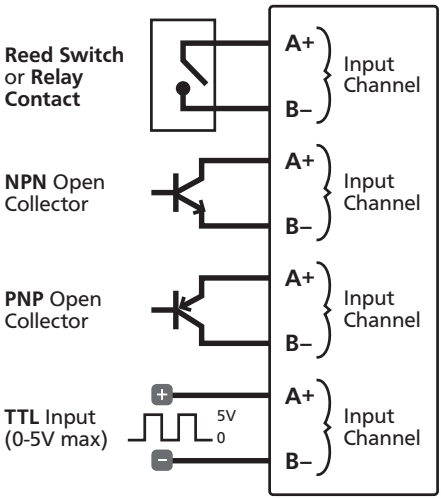
A variety of operating modes are software programmable to suit your application.

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%

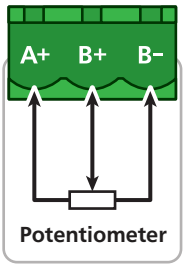
Linearity and repeatability <±0.05% FSO typical

Response time 100msec

Temperature drift <50ppm/°C

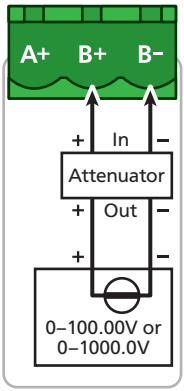
A 3 wire potentiometer is typically used to measure position. A low or high potentiometer range can be programmed to your unit using the WorkBench software.

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



8.7 - Attenuator (sold separately – order code: HVA-1000)

Max input voltage 1000V DC	**Output impedance** 3.8kΩ
Attenuation factor 1000 ±0.1%	**Attenuator type** Differential resistive
Input impedance 3.8MΩ	**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 **defineinstruments.com/zen-iot-registers**

Function	32 bit signed registers	Floating point
Analog inputs		
Ch1	40645 (644) / 40646 (645)	41193 (1192) / 41194 (1193)
Ch2	40647 (646) / 40648 (647)	41195 (1194) / 41196 (1195)
Ch3	40315 (314) / 40316 (315)	41197 (1196) / 41198 (1197)
Ch4	40651 (650) / 40652 (651)	41199 (1198) / 41200 (1199)
Ch5	40653 (652) / 40654 (653)	41201 (1200) / 41202 (1201)
Ch6	40655 (654) / 40656 (655)	41203 (1202) / 41204 (1203)
Ch7	40657 (656) / 40658 (657)	41205 (1204) / 41206 (1205)
Ch8	40659 (658) / 40660 (659)	41207 (1206) / 41208 (1207)
Ch9	40661 (660) / 40662 (661)	41209 (1208) / 41210 (1209)
Ch10	40663 (662) / 40664 (663)	41211 (1210) / 41212 (1211)
Ch11	40665 (664) / 40666 (665)	41213 (1212) / 41214 (1213)
Ch12	40667 (666) / 40668 (667)	41215 (1214) / 41216 (1215)
Ch13	40669 (668) / 40670 (669)	41217 (1216) / 41218 (1217)
Ch14	40671 (670) / 40672 (671)	41219 (1218) / 41220 (1219)
Ch15	40673 (672) / 40674 (673)	41221 (1220) / 41222 (1221)
Ch16	40675 (674) / 40676 (675)	41223 (1222) / 4124 (1223)
Auxiliary registers		
Aux1	40315 (314) / 40316 (315)	41595 (1594) / 41596 (1595)
Aux2	40317 (316) / 40318 (317)	41597 (1596) / 41598 (1597)
Aux3	40319 (318) / 40320 (319)	41599 (1598) / 41600 (1599)
Aux4	40321 (320) / 40322 (321)	41601 (1600) / 41602 (1601)
Aux5	40323 (322) / 40324 (323)	41603 (1602) / 41604 (1603)

Function	32 bit signed registers	Floating point
Aux6	40325 (324) / 40326 (325)	41605 (1604) / 41606 (1605)
Aux7	40327 (326) / 40328 (327)	41607 (1606) / 41608 (1607)
Aux8	40329 (328) / 40330 (329)	41609 (1608) / 41610 (1609)
Aux9	40331 (330) / 40332 (331)	41611 (1610) / 41612 (1611)
Aux10	40333 (332) / 40334 (333)	41613 (1612) / 41614 (1613)
Aux11	40335 (334) / 40336 (335)	41615 (1614) / 41616 (1615)
Aux12	40337 (336) / 40338 (337)	41617 (1616) / 41618 (1617)
Aux13	40339 (338) / 40340 (340)	41619 (1618) / 41620 (1619)
Aux14	40341 (341) / 40342 (341)	41621 (1620) / 41622 (1621)
Aux15	40343 (342) / 40344 (343)	41623 (1622) / 41624 (1623)
Aux16	40345 (344) / 40346 (345)	41625 (1624) / 41626 (1625)
Counters		
CounterA	40525 (524) / 40526 (525)	41805 (1804) / 41806 (1805)
CounterB	40527 (526) / 40526 (527)	41807 (1806) / 41808 (1807)
CounterC	40529 (528) / 40526 (529)	41809 (1808) / 41810 (1809)
CounterD	40531 (530) / 40526 (531)	41811 (1810) / 41812 (1811)
Totalizers		
Total1	40289 (288) / 40290 (289)	41569 (1569) / 41570 (1569)
Total2	40291 (290) / 40292 (291)	41571 (1570) / 41572 (1571)
Total3	40293 (292) / 40294 (293)	41573 (1572) / 41574 (1573)
Total4	40295 (294) / 40296 (295)	41575 (1574) / 41576 (1575)
Total5	40297 (296) / 40298 (297)	41577 (1576) / 41578 (1577)
Total6	40299 (298) / 40300 (299)	41579 (1578) / 41580 (1579)
Total7	40301 (300) / 40302 (301)	41581 (1580) / 41582 (1581)
Total8	40303 (302) / 40304 (303)	41583 (1582) / 41584 (1583)
Total9	40305 (304) / 40306 (305)	41585 (1584) / 41586 (1585)
Total10	40307 (306) / 40308 (307)	41587 (1586) / 41588 (1587)

Note: *The Zen IoT uses a swapped word order for Modbus 32 bit values (integers and floats). It sends/ receives a 32 bit value as least significant word first, followed by the most significant word.*

Integer Example: if the integer value is 100,000 (0x000186A0), the LSW 0x86A0 will be sent first, followed by the MSW 0x0001. Float Example: if the float is value is 1.234 (0x3F9DF3B6), the LSW 0xF3B6 will be sent first, followed by the MSW 0x3F9D.

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
Power LED flashes orange every 2-3 seconds continuously AND data log samples have inaccurate time/date	The most likely cause of this error is the long-life battery for the real-time clock backup needs to be replaced. Contact our service center for further instruction.
Power LED stays red continuously	If the power LED stays red continuously this indicates an internal error which will need to be assessed by the manufacturer. Please return the Nimbus to the manufacturer for analysis and repair.
Cannot power up unit	Check the power supply connections and supply range.
Power LED flashes orange multiple times followed by a 2-3 second pause	The Nimbus has encountered a non-critical error. Count the number of orange flashes between the pauses and contact our service center for further instruction. (Note: the meaning of this condition may change with custom applications so be sure to mention if you are running a custom application)
Power LED is mostly off but flashes a short red pulse every 3 seconds	The Nimbus does not have enough power supplied for it to run correctly. Check that the power supply voltage meets the requirements shown in section 7.5 of this manual.

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 (incl. the Zen IoT) 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	10V/m (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.

Define Instruments

New Zealand (Head Office)

10B Vega Place, Rosedale,
Auckland 0632, New Zealand

PO Box 245 Westpark Village,
Auckland 0661, New Zealand

Ph: +64 (9) 835 1550
Fax: +64 (9) 835 1250

sales@defineinstruments.co.nz

www.defineinstruments.com

United States (Dallas, TX)

Ph: (214) 926 4950

sales@defineinstruments.com

www.defineinstruments.com