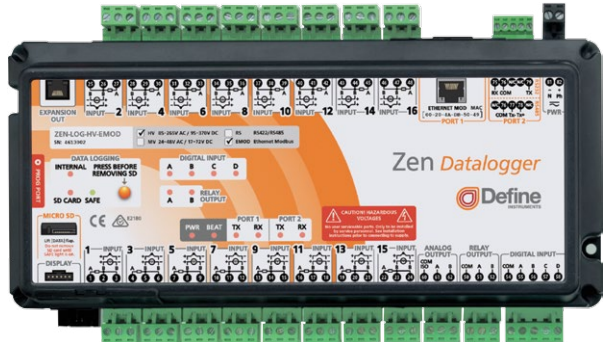# Zen Datalogger
Data Logging Control Station

› **16 Isolated Inputs**
T/C, RTD, mA, mV, V, Potentiometer and more

› **Data logging up to 1GB**
With removable SD card

› **Modbus option**
For easy integration with SCADAs and PLCs

› **Fully featured**
2 Relay outputs, 2 Analog outputs, 4 Digital inputs, HMI connection, RS232, RS485, RS422, Ethernet

› **Easy USB programming and data log retrieval via your PC**

CE   E2180   **Modbus** MEMBER

General Description

The Zen Datalogger is a stand-alone data logging device. It has logging for up to 30 separate channels, including 16 on-board universal inputs.

Among the most flexible data loggers on the market, the Zen Datalogger is ideal for connecting to a mixture of analog and digital sensors. The inputs are all individually isolated and EMC hardened, making it fit for the most demanding industrial environments.

Data is logged to a 1GB Micro SD card, for easy data retrieval and transport.

Our free WorkBench software enables easy configuration of the unit, as well as download and display of logged data. Each unit can be viewed by 8 simultaneous users over the LAN.

The Zen Datalogger supports a range of interface options including RS232, RS485, RS422 and Ethernet, for simple integration with PLCs and SCADA systems.
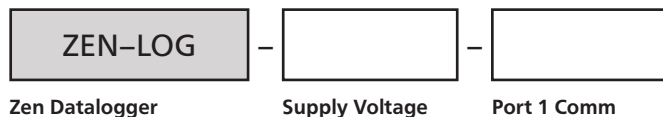
It can be set up as an analog multiplexer, utilizing the onboard dual analog outputs, or as an alarm and control station, using the 16 inbuilt setpoints. These setpoints can trigger up to 16 relay contacts if connected to the optional ZEN-RIO (sold separately).

The setpoints can also trigger SMS and email alarms if the unit is connected to an external cellular modem and loaded with the modem plugin (found in WorkBench).

ZEN-LOG-MAN-16V03 (0930)

CONTENTS

ORDER CODES

ZEN–LOG	–		–	
Zen Datalogger		**Supply Voltage**		**Port 1 Comm**

Supply Voltage	**HV**	85–265V AC / 95–370V DC
	MV	24–48V AC / 17–72V DC
Port 1 Comm	**RS**	RS422/485
	EMOD	Ethernet Modbus

SAFETY NOTICES

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

Symbol definitions

CAUTION
Risk of electric shock
Please refer to user manual.

CAUTION
Risk of danger
Please refer to user manual.

Both direct and alternating current.

Equipment protected throughout by DOUBLE INSULATION or REINFORCED INSULATION.

ZEN-LOG-MAN-16V03 (0930)

1 SPECIFICATIONS

Power

Power supply
HV = 85–265V AC / 95–370V DC, **OR**
MV = 24–48V AC / 17–72V DC

Supply frequency 50/60Hz, 10VA

Mains isolation 250V AC

Mains isolation test voltage to all inputs and outputs 3000V AC 50Hz for 1min

Analog input

16 x Universal isolated analog inputs
See Section 7 for 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 7)

General specifications

HMI interface For FM1602 remote display (sold separately)

Expansion interface Add 16 relay outputs and 16 digital control inputs with a ZEN-RIO Relay/IO Expansion (sold separately)

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 output

2x Isolated analog outputs 4–20mA

Resolution 15 bits, 16,000 steps

Compliance voltage 10V 500Ω

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

Relay output

2x Isolated relay outputs

LED indication of each output

Relay contact rating 5A 30V DC

Digital input

4 x Opto isolated inputs with LED indication of each 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

Input voltage 5–30V DC

Threshold 4.6V typical

Debounce counter range 0–100Hz

Load At 5V DC: 1.1mA; At 24V DC: 7mA

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

Comms

Protocols Modbus RTU, RS422, RS485 or RS232

Port 1 Select either:
RS = RS422 / RS485, **OR**
EMOD = Ethernet Modbus (10/100/Auto)

Port 2 RS232 / RS485 auto-select
Selectable baud rate 2400–230000 baud
Format 8 bit, no parity, 1 stop

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

Programming

USB programmable Via USB prog port using Bridge Key USB programmer (sold separately)

Define WorkBench Simple configuration and data log retrieval using Define WorkBench.

Datalogging

Real-time clock

Data logging to Micro SD card (supplied). Logging to onboard memory when Micro SD card removed

Micro SD card capacity
1GB (7,858,683 samples for all channels)
Not compatible with higher-capacity Micro SD cards.

Onboard memory capacity
32MB (31,774 samples for all channels)
Used when Micro SD card is removed

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

Construction

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

Dimensions (H x W x D, with plugs in)
2.32 x 10.04 x 5.67" (59 x 255 x 144mm)

Unit weight ZEN-LOG-RS = 27.2oz (770g)
ZEN-LOG-EMOD = 27.7oz (784g)

Environmental conditions

Operating temp 14 to 140°F (−10 to 60°C)

Storage temp −4 to 176°F (−20 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

Intelligent multiplexer

Channel selection Binary (digital inputs)

Cycle time 4sec minimum to cycle through all 16 inputs

Resolution 12 bits, 4000 steps typical

2 DIMENSIONS & INSTALLATION

2.1 - Case dimensions

Ø 0.18"
(4.5mm)

4.55"
(115.5
mm)

Micro SD Port

2.52"
(64
mm)

9.69" (246mm)

10.04" (255mm)

5.69" (144.4mm)

2.35"
(59.8mm)

DIN Rail   Programming Port
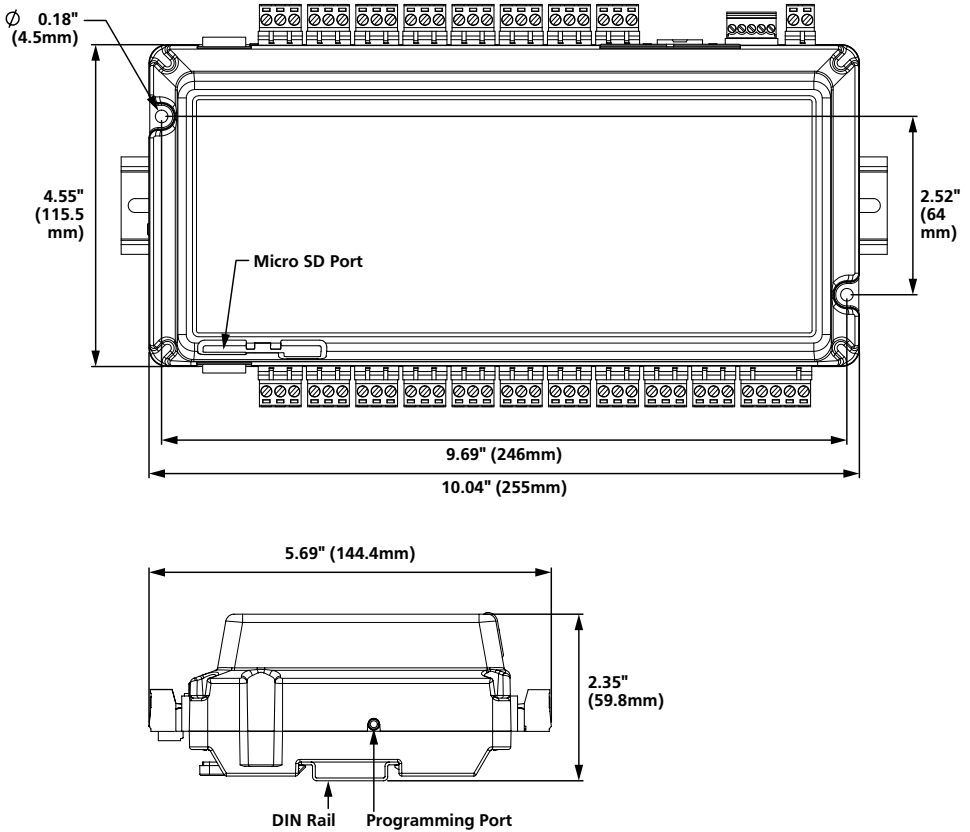
2.2 - Installation environment

The Zen 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.**

2.3 - Installation instructions

The Zen Datalogger is rated IP20, and should be mounted in an enclosure to protect the unit from weather conditions and dust.

A - Installation in Enclosure (Fig 1)

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

If using a metal enclosure, the enclosure must be earthed.

B - DIN Rail Mounting (Fig 2)

To clip the unit onto the DIN rail:
(**1**) Hook the lower part of the unit onto the rail, and then
(**2**) Press down towards the rail until the red hooks click into place

Leave at least 2" (5cm) clear above and below the unit, to allow room for airflow and wiring.

C - Wiring

Refer to Sections 6–7 in this manual.

D - Removal from DIN Rail (Fig 3)

To remove the unit from the DIN rail:
(**1**) Power down the unit
(**2**) Unplug the 'Input 4' and 'Port 1' connectors from the top of the Zen (the DIN clips are behind these terminals)
(**3**) Gently pull the unit away from the rail while levering one of the clips upward with a screwdriver
(**4**) When one side is loosened, hold it slightly away from the rail to prevent the clip from engaging again (pictured in Fig 3).
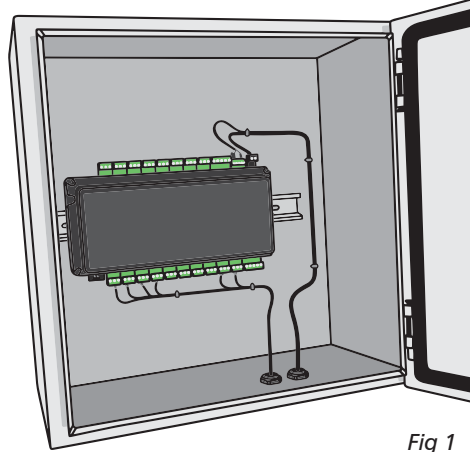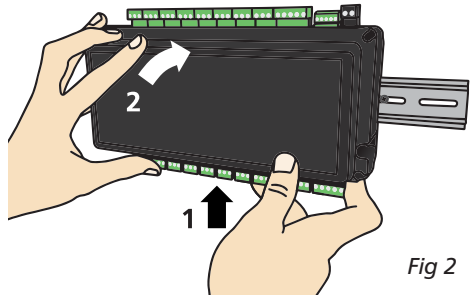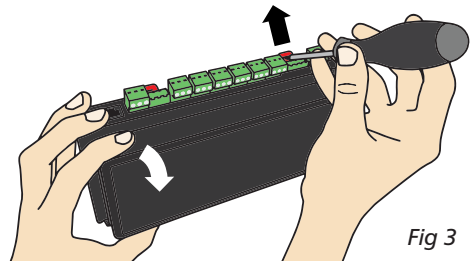Meanwhile, lever the second clip upward as you did with the first.

Fig 1

Fig 2

Fig 3

ZEN-LOG-MAN-16V03 (0930)

2.4 - EMC installation guidelines

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

The Zen 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 Zen can be further improved, by:

A   Installing the unit in an earthed **Metal Enclosure**. 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 Zen.

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. 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 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.

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3 INSTALLING DEFINE WORKBENCH

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

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

A   Call for the latest version of 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).
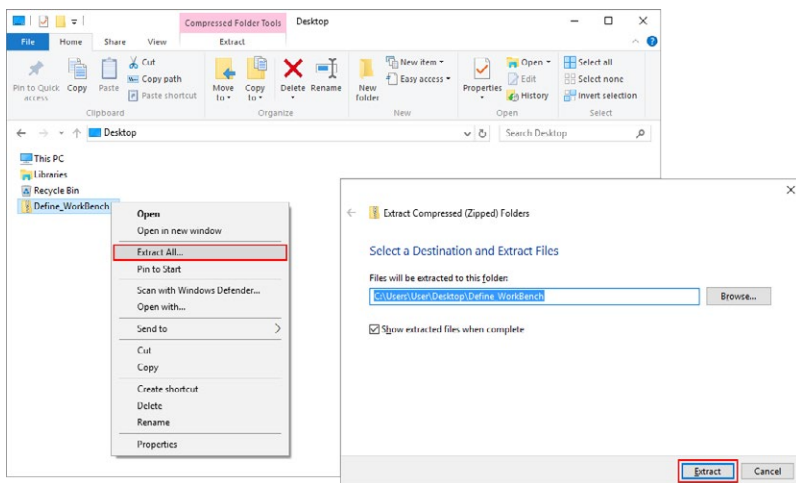
C   Double-click on the extracted **.msi** install file. This will launch the WorkBench installer.

Depending on your security settings, a 'Security Warning' dialog may appear. If you see the security message, click **'Run'**.
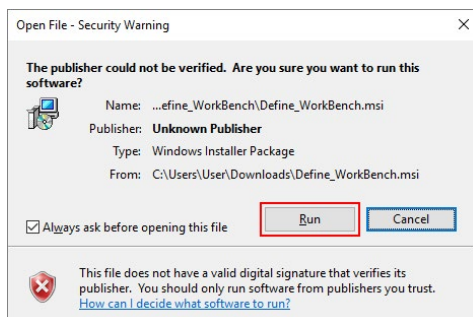
D   The WorkBench setup wizard will launch.

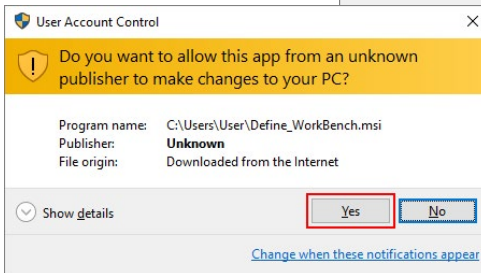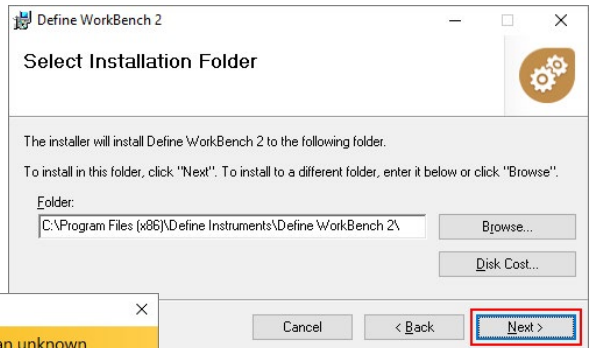Click '**Next**' to get started.
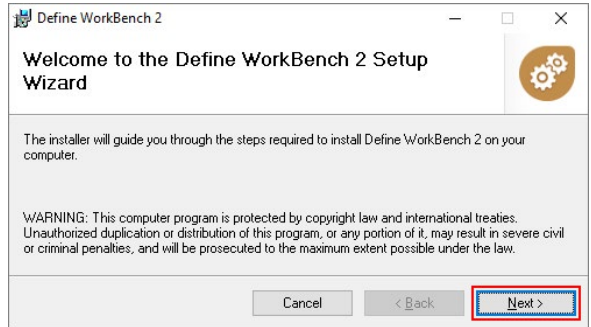
E   The wizard will also ask for confirmation that you wish to begin the installation.

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.
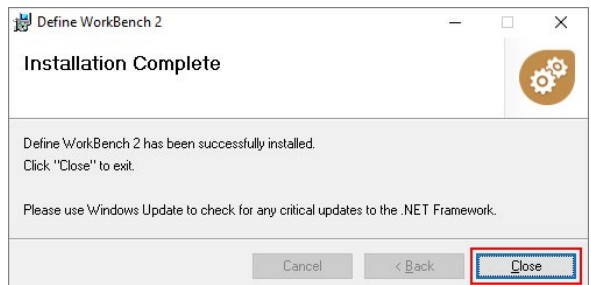
4 SOFTWARE CONFIGURATION

4.1 - Connecting

Connect the Bridge Key

To program your Zen Datalogger, connect one end of the **Interface Cable** to the programming port on the left side of the Zen (see Fig 4), and the other end to your **Bridge Key**.

Then plug the **Bridge Key** into your computer's USB port (see Fig 5).
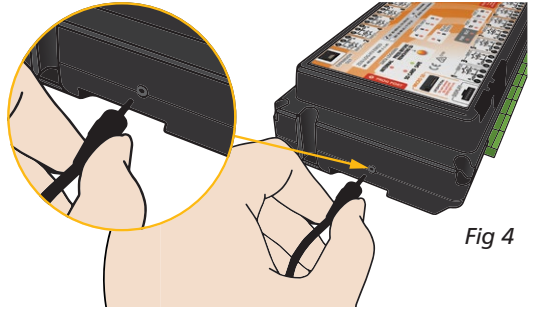
Fig 4

Supply Power

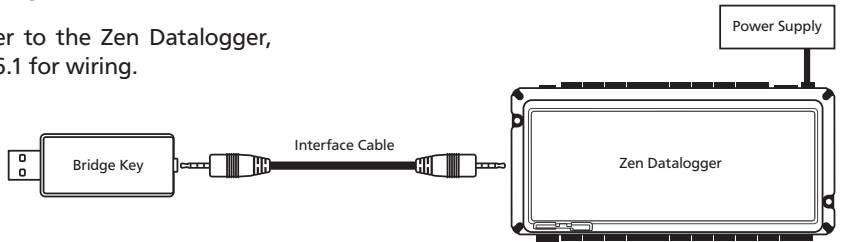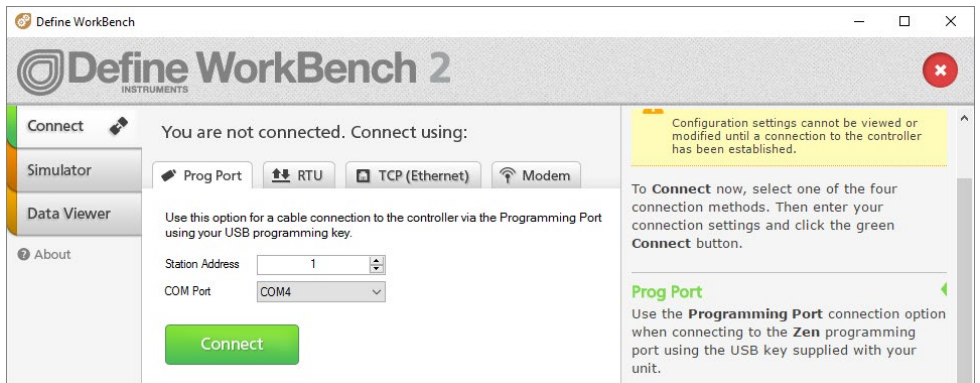Supply power to the Zen Datalogger, referring to 6.1 for wiring.

Connect to your Zen in Define WorkBench

Fig 5

Launch Define WorkBench (see Section 3 for installation instructions), and select the 'Prog Port' tab. If your Zen is powered up and connected via the Bridge Key, then the COM Port will be detected automatically. Click 'Connect'.

4.2 - WorkBench interface overview

Main Navigation, including channel sub-navigation. See 4.3 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 Zen.

4.3 - Main navigation

Overview

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

Ports

This tab is only visible if you are connected to your Zen via the USB Programming Port. It enables you to configure a range of settings for Port 1 and Port 2 (baud rate, parity, Tx delay etc.).

Once your ports are set up, you will be able to configure to your Zen in WorkBench via Port 1 or Port 2 instead of the USB programming port - perfect for adjusting settings once your unit is installed.

Inputs

Set up and scale the 16 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.

Retransmission

Configure up the two analog outputs to operate independently, or in cooperation with the digital inputs as an intelligent multiplexer.

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, complete with detailed explanations.

Relays

Configure the two 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 options. Select the logging interval, set the time, and select which channels will be logged. (See Section 5 for more on Data Logging.)

Data Viewer

View and analyze your live data and download it to your computer. (See Section 5 for more on Data Logging.)

Plugins

Plugins are small programs which are loaded into the Zen to expand its functionality or simplify its use. Plugins are optional and in many cases they may not be needed. Note that only one plugin can be installed on your Zen at a time.

5   DATA LOGGING

5.1 - Data logging capacity

The Zen Datalogger is supplied with a **1GB Micro SD card**, which is the default storage location for logged data. The Micro SD card can hold up to 7.8 million data samples - enough for nearly 15 years' data logging at 1 sample per minute.

If you remove the Micro SD card to download data from it (see 5.5), the Zen will continue to log data to its onboard memory. The onboard memory capacity is 32MB (31,744 data samples) - enough for 22 days' data logging at 1 sample per minute.

Logged data which has been temporarily saved to the onboard memory will be automatically transferred to the Micro SD card as soon as it is inserted again. (This process can take some time, depending on how much data needs to be transferred. You will not be able to safely remove the Micro SD card again [as in 5.5] until the transfer has completed.)

> **NOTE**
> **Please use the supplied 1GB Micro SD card.** Commercially available Micro SD cards with a capacity higher than 1GB are not supported by the Zen Datalogger.

5.2 - Data logging setup

To set your Data Logging preferences, connect to your Zen using Define WorkBench (see Section 4), and click on the "**Logging**" tab.

From there you can:

›   Specify what to do when the data logging capacity is reached (either overwrite old data, or stop logging)
›   Set your logging interval in hours, minutes and seconds
›   Delete your Data Log
›   Set the clock
›   Select which channels to log (up to 30 channels, which may include a mixture of Inputs, Digital Inputs, Totalizers and Auxiliary inputs)

5.3 - Indicators

The Zen Datalogger has 3 LED indicators which provide information on the status of the data log.

Fig 6

A   INTERNAL / SD CARD
These LED's indicate which memory location is currently being used to store logged data:

› If the **'SD CARD'**, LED is lit, then data is being saved to the Micro SD card.
› If the **'INTERNAL'** LED is lit, the data is being saved to the onboard memory.
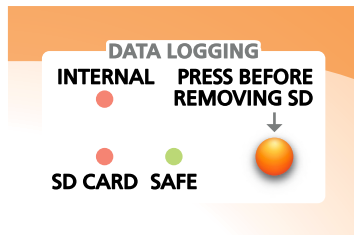
B   PRESS BEFORE REMOVING SD
This button must be pressed BEFORE removing the Micro SD card. (Please see 5.5 for more information on safely removing the Micro SD card.)

C   SAFE
If this LED is lit, then it is safe to remove your SD card from the Zen's Micro SD slot.

5.4 - Using the Data Viewer

Define WorkBench **"Data Viewer"** enables you to view your logged data and visualize it in the form of a Multi-Channel Graph (Fig 7), Tiled Graphs (Fig 8), a Distribution Graph (Fig 9), or as Tabulated Data (Fig 10).

A variety of settings enable you to specify the range of viewable data, and configure your graph axes and labels. You can also export logged data to CSV format for further processing using Excel.

Fig 7 - Multi-Channel Graph

Fig 8 - Tiled Graphs

Fig 9 - Distribution Graph

Fig 10 - Tabulated Data

Downloading logged data

When you connect to your Zen Datalogger in Define WorkBench and click on the **"Data Viewer"** tab, you will have immediate access to any data which has previously been downloaded from the Zen unit.

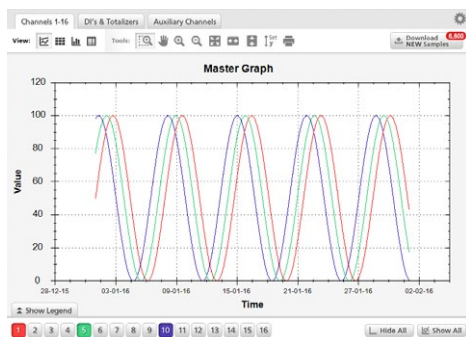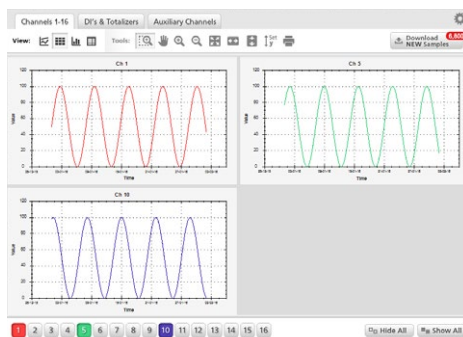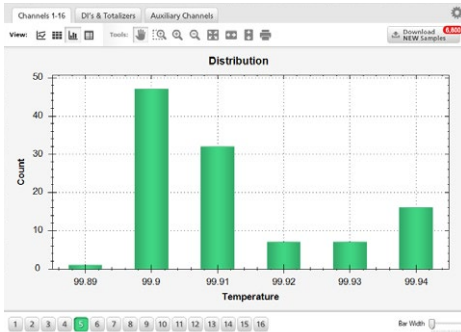Additionally, the graph will show preview content for any data that **has not yet been downloaded** (this is built using 100 samples from your actual data). To view the complete data set, you must download the data log.

Downloading the data log has the additional benefit of enabling 'offline' viewing, making it possible to view your data in Define WorkBench without connecting to your Zen. Regularly downloading your data log will also ensure that your data history is maintained, in the unlikely event that the size of your data log exceeds the capacity of the Micro SD Card.

There are two methods for downloading logged data to your PC:

A   **While connected to your Zen unit, click the "Download NEW Samples" button.**

This button appears in the top right-hand corner of the Data Viewer window, along with the number of samples to be downloaded. If there are only a moderate number of new samples to be downloaded, then this method is ideal.

However please note that this method can take considerable time if there are a large number of samples to be downloaded. In this case it is recommended that you download data from the Micro SD Card, as explained below.

B   **Without connecting to your Zen unit, safely remove the SD Card (see 5.5) and import its contents to WorkBench.**

This is the recommended method for downloading a large data log, because transfer of data is not impeded by distance, or by the speed of your serial or ethernet connection. This method also enables you to download the data log without being connected to a live unit. Please see 5.5 for further instructions.

5.5 - Importing logged data from the Micro SD card

The Micro SD card can be removed from the Zen unit and read using a standard SD card reader, enabling fast, simple and portable data log retrieval.

To do this, you must first unmount the Micro SD card by pressing the button marked 'PRESS BEFORE REMOVING SD'.

This disengages the Micro SD card from the data logging process, causing any subsequent data samples to be logged to the unit's onboard memory. (When the Micro SD card is inserted again, any samples that have been logged to the unit's onboard memory will be transferred to the Micro SD card.)

> ⚠️ **IMPORTANT**
> **Please read and follow these instructions to remove the Micro SD Card from the Zen unit.** Incorrect removal of the Micro SD could corrupt your data log.

A   **Press the button marked 'PRESS BEFORE REMOVING SD'** (see 5.3B).

B   **Wait for the green 'SAFE' LED to come on. When the 'SAFE' light is on, remove the SD card from the Zen unit**. Open the rubber flap marked 'DATA' which is located just above the Display terminal on the lower left-hand side of the unit. Press the SD card to eject it.

C   **Insert the SD card into your computer's card reader**.

D   **Launch Define WorkBench and click on the "Data Viewer" tab.** (Note that you do not need to connect to your Zen Datalogger.)

E   **The 'Data Source' dialog will pop up automatically.** Click **"SD Card Import"** and then follow the steps in the images below to import the data from your Micro SD card.

F   **When you have finished importing the data, return the Micro SD card to the Zen Datalogger.** (You do not need to follow any special process to re-insert the SD card).
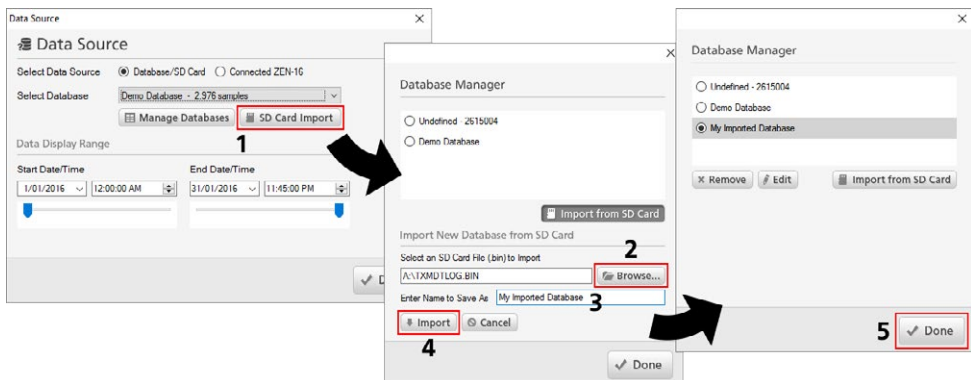
6   WIRING & LED'S

6.1 - Zen Datalogger terminals

Universal Input Channels
See Section 7

Expansion Out

Connection point for **ZEN-RIO** Relay I/O Expansion.

Programming Port

Programming connection to **Define WorkBench** using the **Bridge Key**.

See Section 4 for more information

Micro SD

Use **'PRESS BEFORE REMOVING SD'** button.

Once SAFE light is on:
Open flap to expose slot. Press card to eject.

Max card capacity = 1GB

EXPANSION OUT

25 26 27   28 29 30   31 32 33   34 35 36   37 38 39
B   A   B   A   B   A   B   A   B   A

INPUT — 2   INPUT — 4   INPUT — 6   INPUT — 8   INPUT — 10

ZEN-LOG-HV-EMOD
SN: 4613002   FW: 2.1.01

☑ HV 85–265V AC / 95–370V DC   ☐ RS   RS422/RS485
☐ MV 24–48V AC / 17–72V DC   ☑ EMOD Ethernet Modbu

DATA LOGGING   **DIGITAL INPUT**
INTERNAL   PRESS BEFORE REMOVING SD   A   B   C   D

SD CARD   SAFE   A   B   RELAY OUTPUT

PROG PORT

MICRO SD

Lift [DATA] flap.
Do not remove
SD card until
SAFE light is on.

CE   E2180

PWR   **BEAT**   **PORT 1**   **POR**
    TX   **RX**   **TX**

DISPLAY

1 — INPUT — 3 — INPUT — 5 — INPUT — 7 — INPUT — 9 — INPUT
A   B   B   A   B   B   A   B   B   A   B   B   A   B   B
❶ ❷ ❸   ❹ ❺ ❻   ❼ ❽ ❾   ❿ ⓫ ⓬   ⓭ ⓮ ⓯

Display

HMI port for optional **FM1602** display.
See Appendix B for more information

Universal Input Channels
See Section 7

Port 1
See 6.6

Port 2
See 6.7

Power Supply
Universal AC/DC

– +
N Ph

HV
85–265V AC
95–370V DC

– +
N Ph

MV
24–48V AC
17–72V DC

| 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 |
B B A B B A B B A

INPUT **12**   INPUT **14**   INPUT **16**

ETHERNET MOD   MAC
[00-20-4A-DB-50-49]
PORT 1

| 75 | 76 | N/C | N/C | 79 | RS232 |
RX COM   TX

| N/C | 76 | 77 | 78 | N/C | RS485 |
COM Tx- Tx+
PORT 2

| 81 | 82 |
– +
N Ph
PWR

Zen *Datalogger*

Define INSTRUMENTS

⚠ CAUTION! HAZARDOUS VOLTAGES ⚡
No user serviceable parts. Only to be installed by service personnel. See installation instructions prior to connecting to supply.

T 2
RX
●

11 INPUT **13** INPUT **15** INPUT
A B B A B B A B B
16 17 18 19 20 21 22 23 24

ANALOG OUTPUT
COM ISO A B
60 61 62

RELAY OUTPUT
COM A B
50 51 52

DIGITAL INPUT
COM A B C D
54 55 56 57 58

Analog Outputs
See 6.3

Relay Outputs
See 6.4

Digital Inputs
See 6.5

6.2 - LED indicators

The Zen Datalogger has 15 LED indicators on the top label which provide information about the unit's status, as further explained below:

INTERNAL ON = Using onboard memory for datalog storage
SD CARD ON = Using Micro SD card for datalog storage
SAFE ON = Safe to remove Micro SD card

ON = Digital Input Active
OFF = Digital Input Inactive

DATA LOGGING
INTERNAL   **PRESS BEFORE REMOVING SD**

SD CARD   SAFE

DIGITAL INPUT
A   B   C   D

RELAY OUTPUT
A   B

PWR   BEAT

PORT 1
TX   RX

PORT 2
TX   RX

ON = Relay Energised
OFF = Relay De-energised

ON = Power is supplied to the unit

Indicates activity on the Receive/Transmit lines

FLASHING = Normal operation
ON = Error (contact manufacturer)

6.3 - Analog output

The two Analog Outputs (A–B) can be wired as shown (right) and configured and scaled in Define WorkBench from the '**Retransmission**' tab.

The Zen Datalogger can also be configured as an Intelligent Multiplexer from the '**Retransmission**' tab (see Section 8) - in this case the Digital Inputs are disabled.

60   61   62

COM

A
4–20mA

B
4–20mA

−   +   −   +

Indicator or PLC   Indicator or PLC
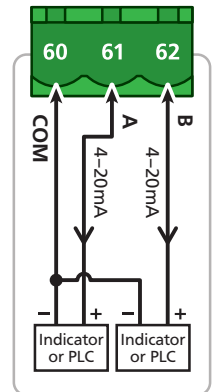
6.4 - Relay output

The two Relay Outputs (A–B) can be wired as shown (right) and configured in Define WorkBench from the **"Relays"** tab. Each Relay Output has LED indication on top of the unit to indicate when the relay is energized.

Both relays are normally open, and share a common. Each can be configured for a 'Closed' or 'Open' triggered state (e.g. for fail safe operation). These settings are retained in software on power down, but the relays are de-energized.
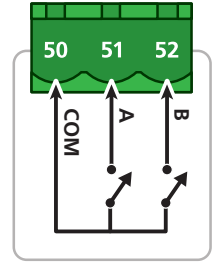
Connection example for relay outputs
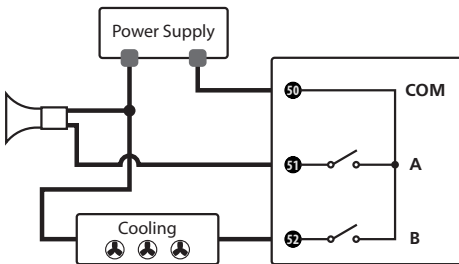
Note 1 30V AC/DC, 1A maximum contact rating.

Note 2 For individual relay outputs (i.e. not sharing a common) and/or a contact rating of 250V AC, use ZEN-RIO, which can provide 16 Relay Outputs.

6.5 - Digital inputs

The Zen Datalogger has four Digital Inputs (A–D), each with LED indication on top of the unit. The digital inputs 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)

The Zen Datalogger can also be configured as an Intelligent Multiplexer from the **'Retransmission'** tab (see Section 8) - in this case the Digital Inputs are disabled.
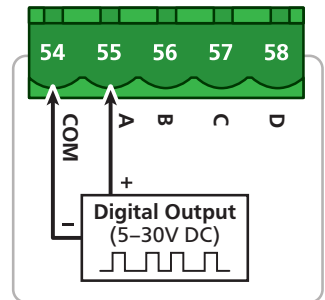
Please see p22 for more wiring diagrams.

ZEN-LOG-MAN-16V03 (0930)
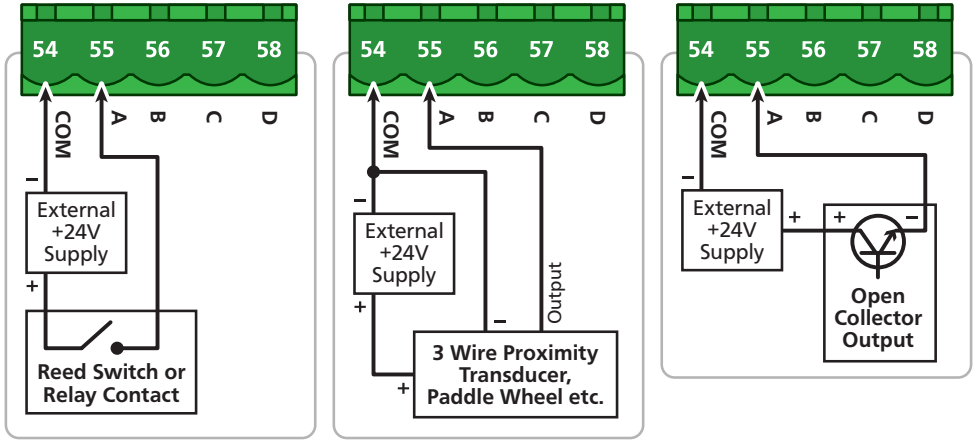
NOTE

The universal analog inputs can also be wired as digital pulse inputs (see 7.5).

Connection example for digital inputs (A–D)

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

Note 2 Do not fit the 4K7 resistor for 3-Wire PNP transducers.
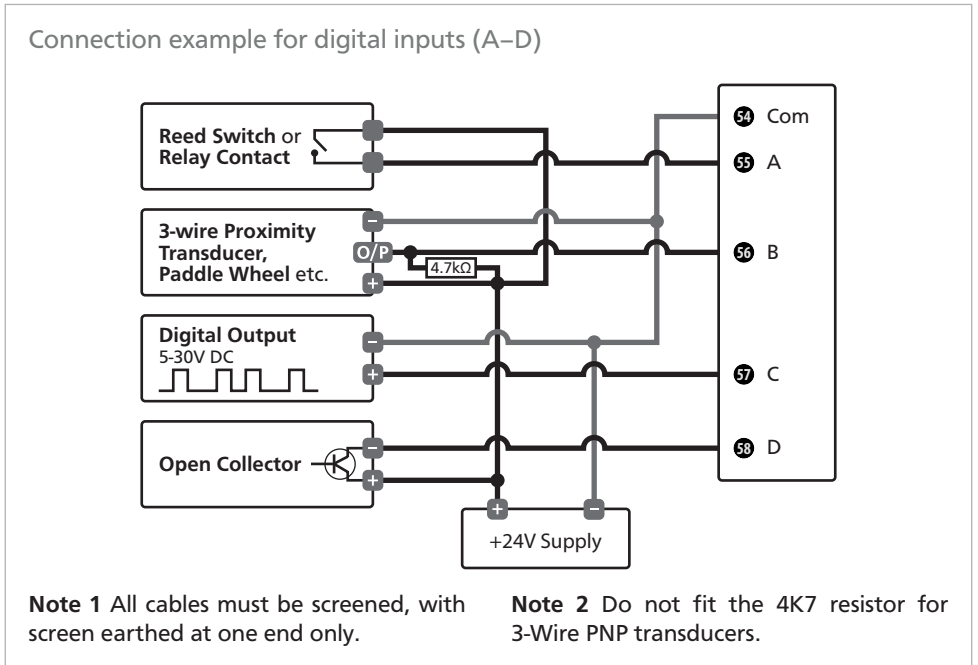
6.6 - Port 1

Port 1 on the Zen Datalogger can be purchased with an auto-detecting RS485/RS422 port (order code '-RS'), or as an Ethernet Modbus terminal (order code '-EMOD'). If you have the auto-detecting RS port, refer to the diagrams below for wiring.
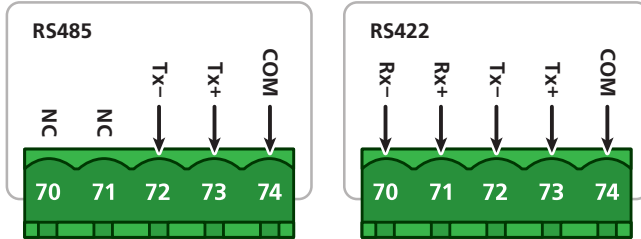
NOTE
Pins marked 'NC' MUST be left disconnected to ensure correct auto-detection of your comm type.

6.7 - Port 2

Port 2 can be wired for either RS232 or RS485 serial connection, as shown (right).

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

7   INPUT WIRING & SPECIFICATIONS

> ⚡ **CAUTION**
> **Risk of electric shock.** Dangerous and lethal voltages may be present on the input termi-nals. Please take appropriate precautions to ensure safety.

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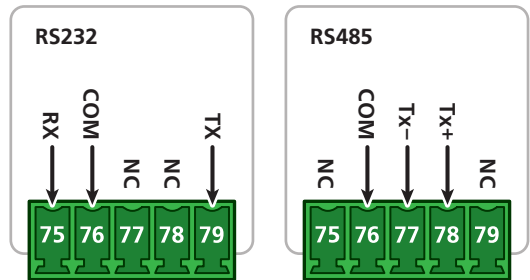> **Risk of danger.** The sensor input can potentially float to dangerous and unexpected volt-ages depending on what external circuit it is connected to. Appropriate considerations must be given to the potential of the sensor input with respect to earth common.

7.1 - 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.

Current
0/4–20mA

2 Wire Loop Powered Transmitter
4–20mA

3 Wire Transmitter
0/4–20mA

4 Wire Transmitter
0/4–20mA

Fail-Safe Micro Switch

If you are connecting other instruments in a loop with a Zen mA input, a fail-safe has been added to prevent the external loop from being interrupted in the event of a power loss to the Zen.

To activate the fail-safe for an input channel, turn on the micro switch above the input terminal. You will need to remove the input connector to see the switch, and use a small screwdriver to turn it on.

Fail-safe Micro Switch
OFF ⟷ ON
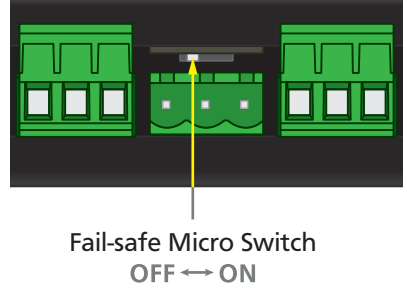
📌 **NOTE**

The Fail-Safe Micro Switch is only compatible with mA inputs.
For the accurate operation of this instrument, it is critical that the micro switch be set to the OFF position for all other input types.

Connection example for 2, 3 & 4 wire mA output transmitters
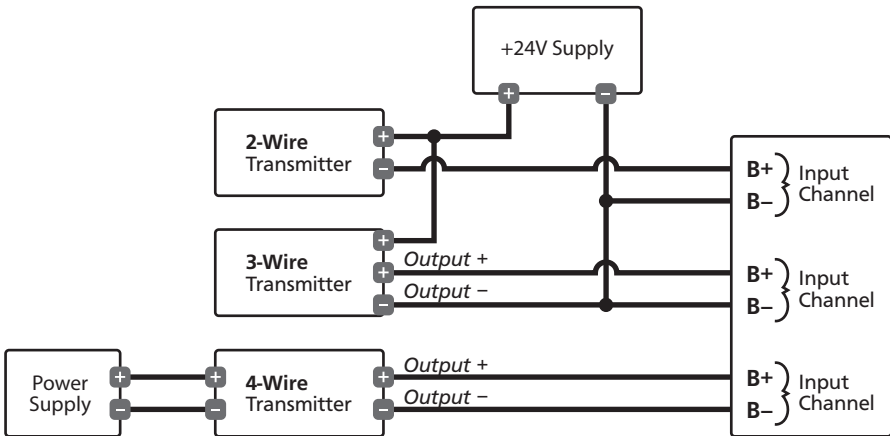
Note 1 All analog inputs are isolated to other channels and all other voltages. They also have built in over voltage protection to 24V, protecting the unit if the 24V supply is inadvertently connected to the unit when configured for mA input.

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 minimise RFI effects, of which magnitude cannot be easily predicted.

7.2 - Voltage input

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

Input impedance >500KΩ on all ranges

Maximum over-voltage 24V DC
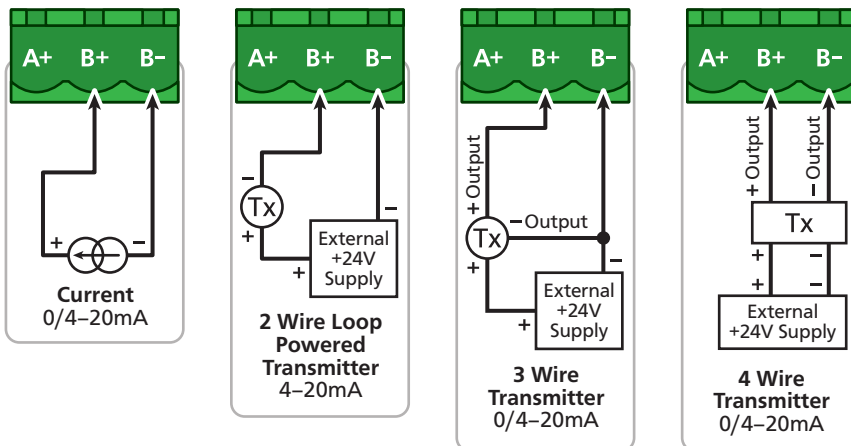
Accuracy 0.1% FSO max

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 Datalogger 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.
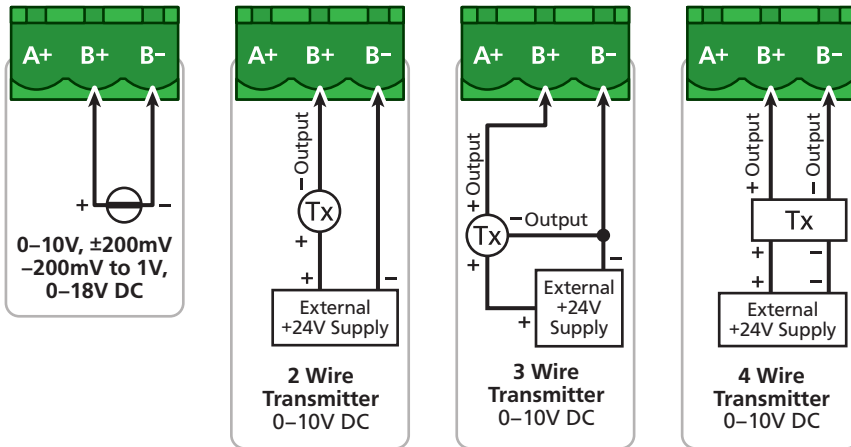
Connection Example for Millivolt & Voltage Inputs for 2, 3 & 4 Wire Transmitters
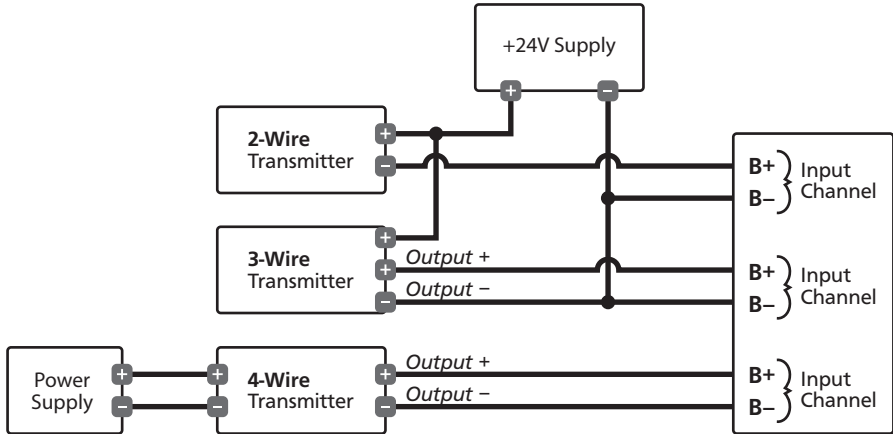
Note 1 Each voltage input must not see more than 18V peak between the negative and the input, otherwise permanent damage may occur.

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 minimise RFI effects, of which magnitude cannot be easily predicted.

7.3 - 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
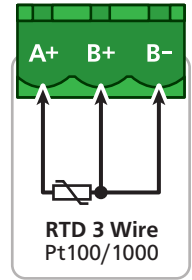-328–1472°F (-200–800°C) = ±0.3°C

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.
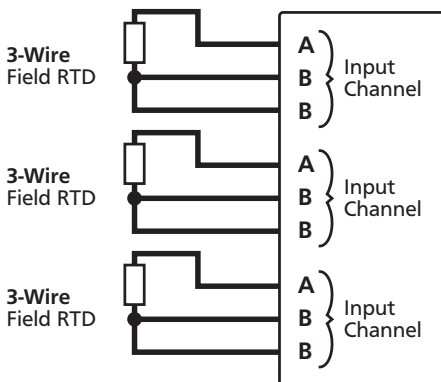

RTD 3 Wire
Pt100/1000

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

3-Wire Field RTD — A B B Input Channel

3-Wire Field RTD — A B B Input Channel

3-Wire Field RTD — A B B Input Channel

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 minimise 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 minimise RFI effects, of which magnitude cannot be easily predicted.

7.4 - 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.

A+   B+   B−
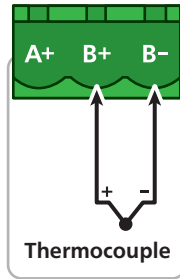
Thermocouple

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

T/C — B+ B− } Input Channel

T/C — B+ B− } Input Channel

T/C — B+ B− } Input Channel
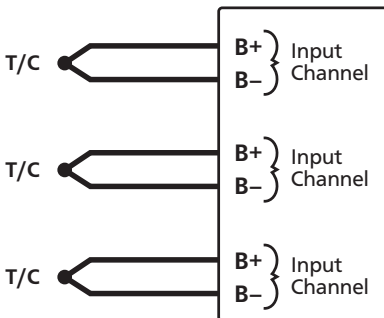
Note 1 All thermocouple inputs are isolated from each other. There is no need to buy expensive isolated thermocouples.

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 minimise RFI effects, of which magnitude cannot be easily predicted.

7.5 - 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
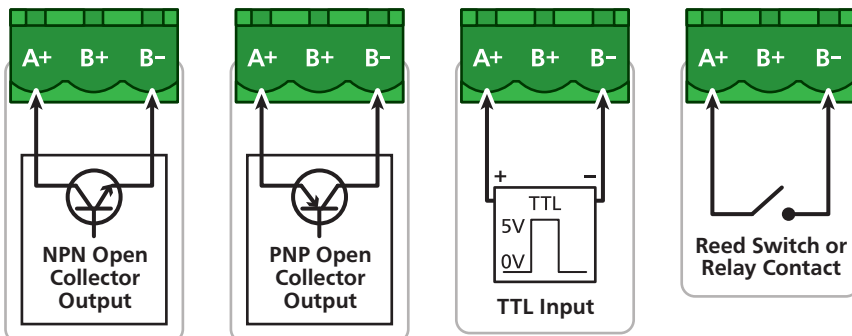
Counter register output 32 bit

Accuracy ±0.5%

The Zen's 16 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).
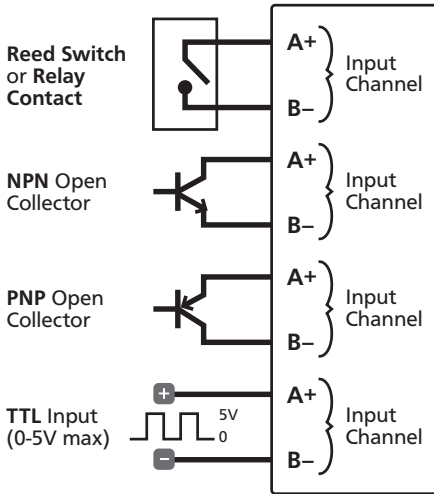
A variety of operating modes are software programmable to suit your application.

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)

NPN Open Collector Output

PNP Open Collector Output

TTL Input

Reed Switch or Relay Contact

Connection Example for Digital Pulse Inputs

Reed Switch or Relay Contact

A+ B− Input Channel

NPN Open Collector

A+ B− Input Channel

PNP Open Collector

A+ B− Input Channel

TTL Input (0-5V max)

+ − 5V 0

A+ B− Input Channel

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 minimise RFI effects, of which magnitude cannot be easily predicted.

7.6 - 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.

A+ B+ B−

Potentiometer
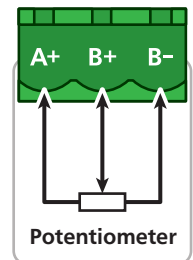
7.7 - AC current sensor

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

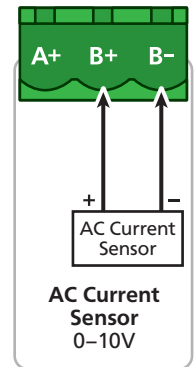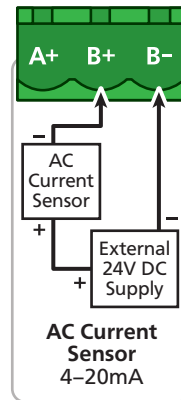**Accuracy** 1% of full scale

Response time 250ms (10–90%)

Frequency 50–60Hz

The Zen Datalogger 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

High ↕ Mid

AC Current Sensor 4–20mA

AC Current Sensor 0–10V

7.8 - Attenuator

Max input voltage 1000V DC
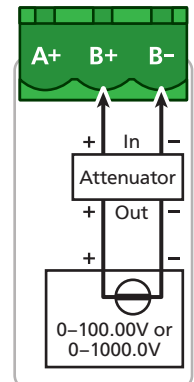
Attenuation factor 1000 ±0.1%

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).
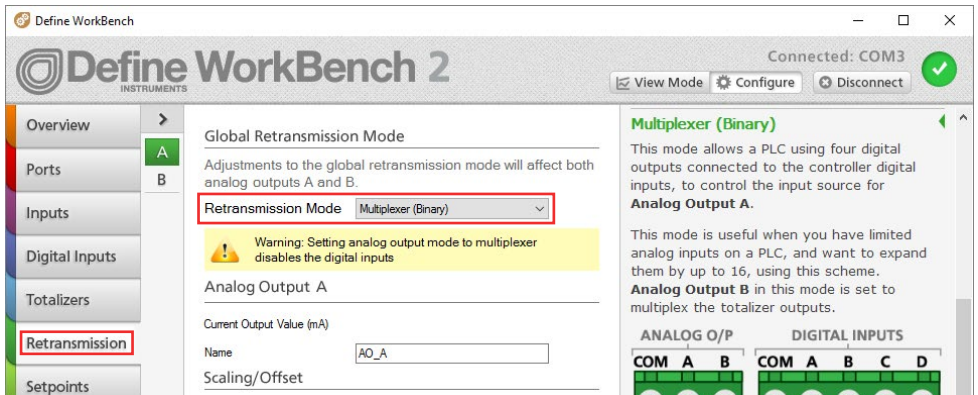Wire the attenuator as shown.

0–100.00V or
0–1000.0V

8   CONNECTING TO A PLC

8.1 - Connecting to a PLC as an intelligent multiplexer

the Zen Datalogger can easily be configured as an intelligent multiplexer via the 'Retransmission' tab in Define WorkBench. To do this, select '**Multiplexer (Binary)**' as the **Retransmission Mode** and wire the unit as shown below.
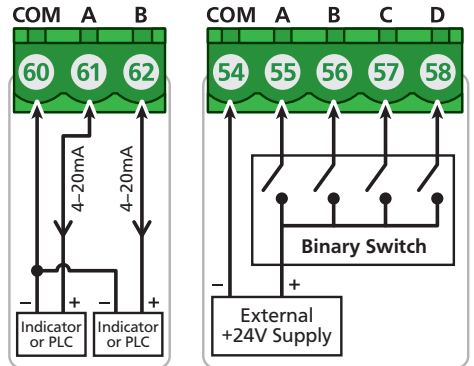

Specifications

Settling time before reading 100msec min. Multiple readings with averaging recommended. (Longer times may be required for longer cable lengths and higher resolution.)

Binary signal magnitude 5–30V DC

Cycle time 4sec min to cycle through all 16 inputs

Resolution 15 bits, 16,000 steps typical

Analog Output   **Digital Inputs**

📌 **NOTE**

Multiplexer Mode uses both the Retransmission Outputs and the Digital Inputs.
Digital Inputs can no longer be configured independently via the 'Digital Inputs' tab.

Binary Channel Selection

The Binary Channel selection is PLC RTX, and uses the four digital inputs (A–D), as shown below:

› DI Com = CS Com
› DI A = Bin 1
› DI B = Bin 2
› DI C = Bin 4
› DI D = Bin 8

A binary value of '0' indicates no voltage on the terminal, while a value of '1' indicates 5–30V DC on the terminal.

DI A BIN 1	DI B BIN 2	DI C BIN 4	DI D BIN 8	Retrans. Channel
0	0	0	0	**1**
1	0	0	0	**2**
0	1	0	0	**3**
1	1	0	0	**4**
0	0	1	0	**5**
1	0	1	0	**6**
0	1	1	0	**7**
1	1	1	0	**8**
0	0	0	1	**9**
1	0	0	1	**10**
0	1	0	1	**11**
1	1	0	1	**12**
0	0	1	1	**13**
1	0	1	1	**14**
0	1	1	1	**15**
1	1	1	1	**16**

Notes & Recommendations

› Analog Output A is used to retransmit the input process values 1–16, and Analog Output B is used to retransmit the controller setpoints 1–16.

› The input and output always share the same range. E.g. If Input 1 is ranged 32–212°F (0–100°C) and retransmission Channel 1 is selected on DI A–D, then AO A and AO B are both transmitted as 4–20mA = 32–212°F (0–100°C). Similarly, if Input 2 is ranged for 32–482°F (0–250°C), then AO A and AO B are transmitted as 32–482°F (0–250°C).

› If AO A process value or AO B setpoint are transmitted to an indicator, then all the inputs must be ranged the same, (unless the indicator is ranged to 0–100%).

› In the PLC RTX modes, AO B always retransmits the controller setpoint regardless of whether the controller is enabled or not.

› The PLC RTX modes can operate simultaneously with the Scada Comms, allowing a PLC to read back data that the Scada will be showing.

› If multiple Zen units are wired to the same PLC, then it is recommended that the analog inputs to the PLC be isolated.

Connection example for an intelligent multiplexer
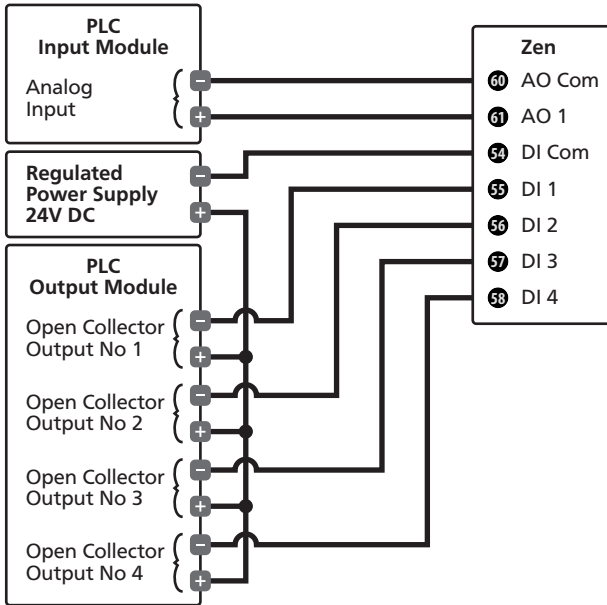
Note 1 In this configuration the DI Com and digital inputs are isolated from the inputs and outputs. The 24V external power supply can therefore be used to power transmitters connected to the Zen's inputs.

Note 2 Each digital input draws 10mA at 24V DC.

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

Note 4 There is no limit to the number of Zens that can be connected, except that the power supply and open collector outputs must be able to handle the load.

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8.2 - Zen registers

Below is a list of the commonly used Zen Datalogger registers. For a full register list, please call for the Zen Registers document.

Analog inputs 32 bit signed registers

Ch1=	645/646	**Ch2=**	647/648
Ch3=	649/650	**Ch4=**	651/652
Ch5=	653/654	**Ch6=**	655/656
Ch7=	657/658	**Ch8=**	659/660
Ch9=	661/662	**Ch10=**	663/664
Ch11=	665/666	**Ch12=**	667/668
Ch13=	669/670	**Ch14=**	671/672
Ch15=	673/674	**Ch16=**	675/676

Analog inputs 32 bit floating point

Ch1=	1193/1194	**Ch2=**	1195/1196
Ch3=	1197/1198	**Ch4=**	1199/1200
Ch5=	1201/1202	**Ch6=**	1203/1204
Ch7=	1205/1206	**Ch8=**	1207/1208
Ch9=	1209/1210	**Ch10=**	1211/1212
Ch11=	1213/1214	**Ch12=**	1215/1216
Ch13=	1217/1218	**Ch14=**	1219/1220
Ch15=	1221/1222	**Ch16=**	1223/1224

Counter/frequency inputs 32 bit signed integers

Counter1=	525/526
Counter2=	527/528
Counter3=	529/530
Counter4=	531/532

Totalizers 32 bit signed integers

Total1=	289/290	**Total2=**	291/292
Total3=	293/294	**Total4=**	295/296
Total5=	297/298	**Total6=**	299/300
Total7=	301/302	**Total8=**	303/304
Total9=	305/306	**Total10=**	307/308

9   MAINTENANCE

9.1 - Calibration

Your Zen Datalogger has been fully calibrated at the factory, and can be recalibrated in software using Define WorkBench (see Section 4). Scaling to convert the input signal to a desired display value is also done using WorkBench

If your Zen unit 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.

9.2 - Troubleshooting

Issue	Resolution
Input signal is not reading correctly	*Check positioning of fail-safe micro switch* The fail-safe micro switch should be switched off for all input types except mA. See 7.1 to confirm.
Auto-detecting RS Port is not working	Ensure that any terminal connections marked 'NC' are left open - otherwise the Zen will not be able to auto-detect your serial type.
Beat light stays ON for more than 1 minute	This indicates an error. Please return the Zen RTU 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.

B   APPENDIX B - OPTIONAL FM1602 DISPLAY

The **FM1602** display can be purchased separately to enable fast, field viewing of your input channel data, without connecting to WorkBench. The display is configured to function with your Zen Datalogger automatically, with no setup required.

Simply connect the HMI ribbon cable to your Zen's display port (shown in 6.1). The **FM1602** will immediately display the current values for input channels 1 and 2 (pictured below).

To view other input channels, press the ⬆ and ⬇ buttons to toggle forwards/backwards to the next data pair.
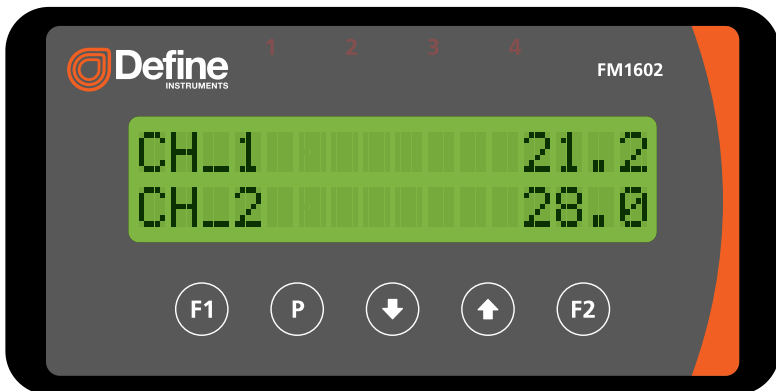
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