solartron metrology

orbit3

DIGITAL NETWORK

# ORBIT®3 MODULE MANUAL

502914

AMETEK
ULTRA PRECISION TECHNOLOGIES

## 1.1 DOCUMENTATION CROSS REFERENCE

| | | |
|---|---|---|
| 502913 | Orbit3 System Manual | Details on installation and electrical requirements. |
| 502915 | Orbit3 Software Manual | Details on programming and using the Orbit3 System |
| 502920 | Orbit3 Catalogue | Describes the Orbit system and provides details of the products including specifications and dimensions. |

For module connecting details see the relevant section of this manual.
For further documentation such as product user leaflets see the Orbit3 Support Pack for Windows CD.

## 1.2 TRADEMARKS AND COPYRIGHTS



## 1.3 CONTACT INFORMATION

For updated information, troubleshooting guide and to see our full range of products, visit our website:
http://www.solartronmetrology.com

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# 3 INTRODUCTION

## 3.1 SCOPE

The Orbit®3 Measurement System is a modular measurement system that can be put together quickly, easily and is cost effective. It allows different types of sensors to be easily mixed and integrated on a single network independent of sensor technology

This manual provides technical information about the Orbit3® Measurement System Modules.

| | |
|---|---|
| Analogue Input Module (AIM) | A module that can take in 3rd party sensors with either voltage of current outputs (E.g. pressure, load cells). A Special variant is available for a PT100 temperature sensor |
| Encoder Input Module (EIM) | A module that can take in a square wave signal from a rotary encoder or line scale. This allows angular position to be easily brought into the Orbit measurement system for profiling. The EIM can also act as a pseudo controller for Dynamic measurement applications. |
| Digital Input Output Module (DIOM) | This module can read discrete inputs and set discrete outputs for control functions. |
| Digimatic Interface Module | This module reads equipments with a digimatic interface such as a Vernier Caliper. |

All of the modules can be mixed together with other Orbit products to generate a measurement system.

Examples

Combine an Encoder Module with a rotary encoder to give angular position and then use this to take readings from Digital Probes to profile a round part.

Add an AIM with a PT100 to monitor the temperature during the measurement cycle

Add an AIM with a load cell to weigh the part.

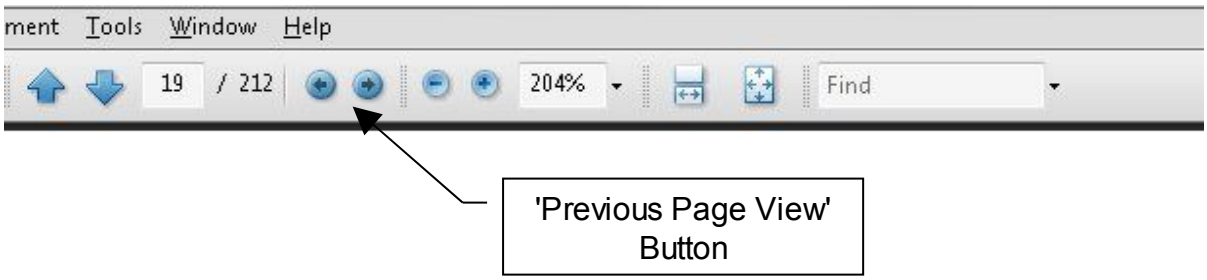
Several Aim can be used with PT100 to monitor and record clean room temperatures for audit trails.

Use the Digital Input Output Module to trigger a PLC to advise a measured part is Ok or not OK.

Use a DIOM to monition interlock relays

## 3.2 NAVIGATE THIS DOCUMENT

This is a large document, which is a useful reference when writing Orbit applications. To aid navigating the document, the following Navigation tip may be useful:
It is often necessary to jump to another item and then go back to where you jumped from.
This can be done in Adobe Reader by using the ‘Previous Page View’ button:




Other PDF readers will have a similar 'Previous Page View' option.

# 4 SAFETY SUMMARY (ALL MODULES)

| | |
|---|---|
| **WARNING** statements identify conditions or practices that could result in personal injury or loss of life.<br><br>**CAUTION** statements identify conditions or practices that could result in damage to the equipment or other property<br><br>**Symbols in this manual**<br><br>  Indicates cautionary or other information | **Warnings and Cautions**<br><br>**Warning:** Do not operate in an explosive atmosphere.<br><br>**Warning:** this equipment is not intended for safety critical applications<br><br>**Warning:** do not exceed maximum ratings as specified in this document under individual modules.<br><br>**Caution: Low Voltage**<br>This equipment operates below the SELV and is therefore outside the scope of the Low Voltage Directive<br><br>**Service and Repair**<br><br>  CAUTION: This equipment contains no user serviceable parts. Return to supplier for all service and repair |

All of the Orbit Modules are **CE** marked and comply with EN50081-1 Electrical Emissions and EN50081-2 Electrical Immunity

# 5 GLOSSARY

Please refer to the Orbit System Manual for information regarding terms used int his document. The Orbit System manual provides a good introduction to the Orbit Measurement System and should be red in conjunction with this document.

## 6 NEW FEATURES WITH ORBIT3

The Orbit3 system provides the following improvements over Orbit2, while still retaining backward compatibility.

- All DP, AIM and DIOM Modules now have Buffered capability supplied as standard.

- All modules have diagnostic/status LEDs , providing indication for:
    - Orbit Bus communication
    - Low or High Orbit Voltage warning
    - Hardware fault
    - Hot Swap Fault/Error.

For further details of Orbit3 improvements, see the Orbit3 System manual.

# 7 ORBIT3 MODULES POWER REQUIREMENTS AND ENVIRONMENT

## 7.1 MODULE POWER CONSUMPTION

| Module | Idle Current | Reading Current | Max Loaded Current |
|---|---|---|---|
| | mA | mA | mA |
| AIM Voltage | 69 | 78 | 78 |
| AIM Current | 71 | 76 | 154 |
| AIM PT100 | 70 | 91 | 91 |
| EIM | 35 | 49 | 1035 see Note1 |
| DIOM | 29 | 42 | 442 |
| DIM | 26 | 41 | 41 |
| DP (Digital Probe) see see Note 2 | 46 | 60 | 60 |

Note 1: this current includes current drawn by the encoder. Therefore the encoder cannot be rated higher than 1000mA. Most encoders are considerably less. If using an encoder which takes a high current please ensure that you have sufficient power available from the Orbit Network. Refer to the Orbit3 System Manual for further information.

Note 2: the Digital Probe is not covered in this manual but the current has been included here for completeness. For further details on the Digital Probe please see the Orbit3 catalog and the Digital Probe User Leaflet.

## 7.2 MODULE OPERATING ENVIRONMENT

| | |
|---|---|
| Temperature | Operating: 0ºC to + 60ºC |
| | Storage: -20ºC to + 85ºC |
| Sealing | IP43 |

# 8 ANALOGUE INPUT MODULE

## 8.1 INTRODUCTION

The Analogue Input module (AIM) enables third party sensors to be easily added to the Orbit® Measurement System. This enables the Orbit3 Measurement System to measure temperature, pressure etc.

**WARNING: Do not exceed 50V input with respect to 0V common**

## 8.2 TECHNICAL SPECIFICATION STANDARD AIM.

### 8.2.1 AIM Inputs

| | |
|---|---|
| Voltage Input Options | ±1V, ±5V, ±10V<br>0V to +5V, 0V to +10V, 0V to +24V |
| Current Input Options | 4-20mA, ±20mA, 0-20mA |
| Voltage Input Impedance | ±1V : 24kΩ<br>others 200kΩ |
| Current Input Impedance | 10Ω |

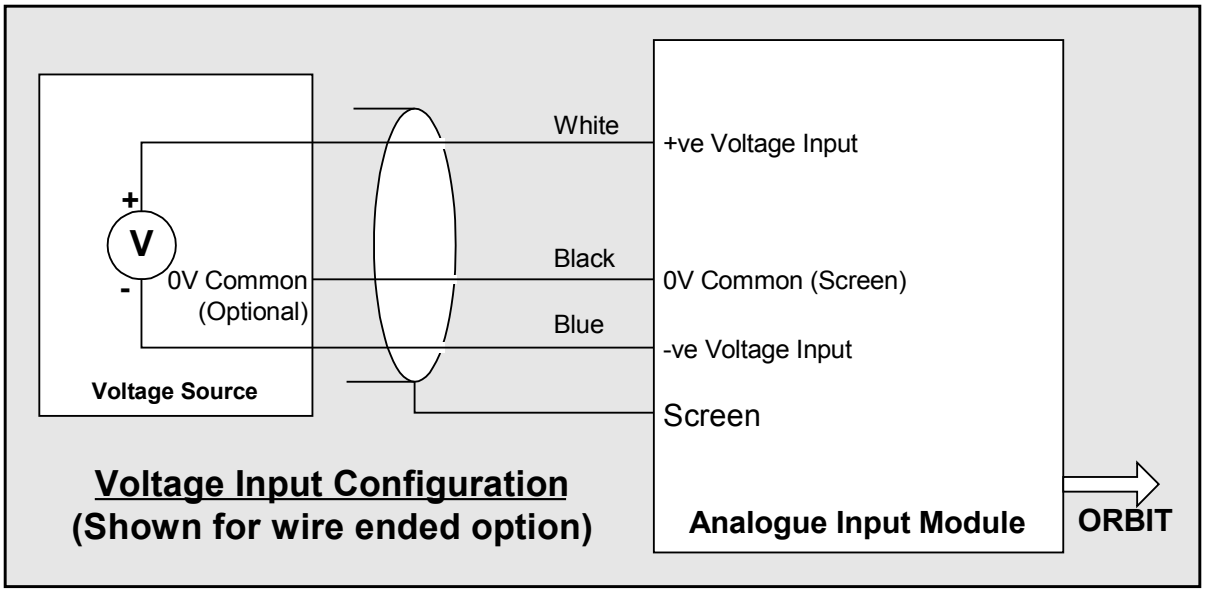
### 8.2.2 AIM Performance

| | | |
|---|---|---|
| Bandwidth | Programmable 6Hz to 460Hz | |
| Resolution | Programmable 14, 16 or 18 bits | |
| Linearity | 0.05% FSO | |
| Offset Voltage | 0V to +5V | 2.5mV |
| | 0V to +10V | 5mV |
| | ±1V, ±5V | 5mV |
| | ±10V | 10mV |
| Offset current | 4-20mA | 20µA |
| | ±20mA | 40µA |
| Temperature Coefficient | Offset | 0.05% FSO/ºC |
| | Span | 0.02% FSO/ºC |
| Warm Up Time | 95% accuracy after 5 minutes from switch on assuming ambient temperature between 10ºC and 30ºC | |

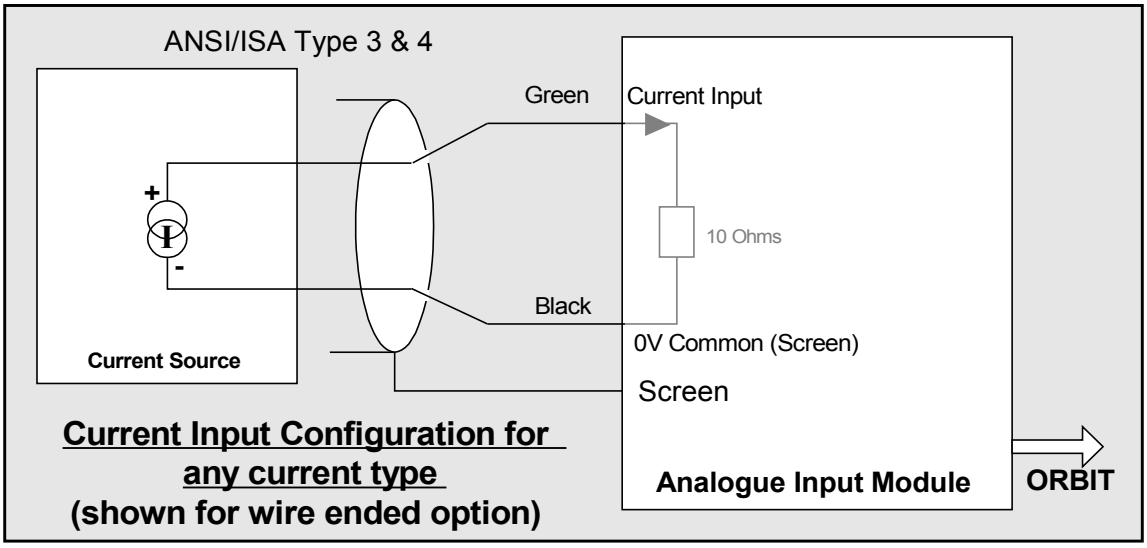
### 8.2.3 AIM Environment

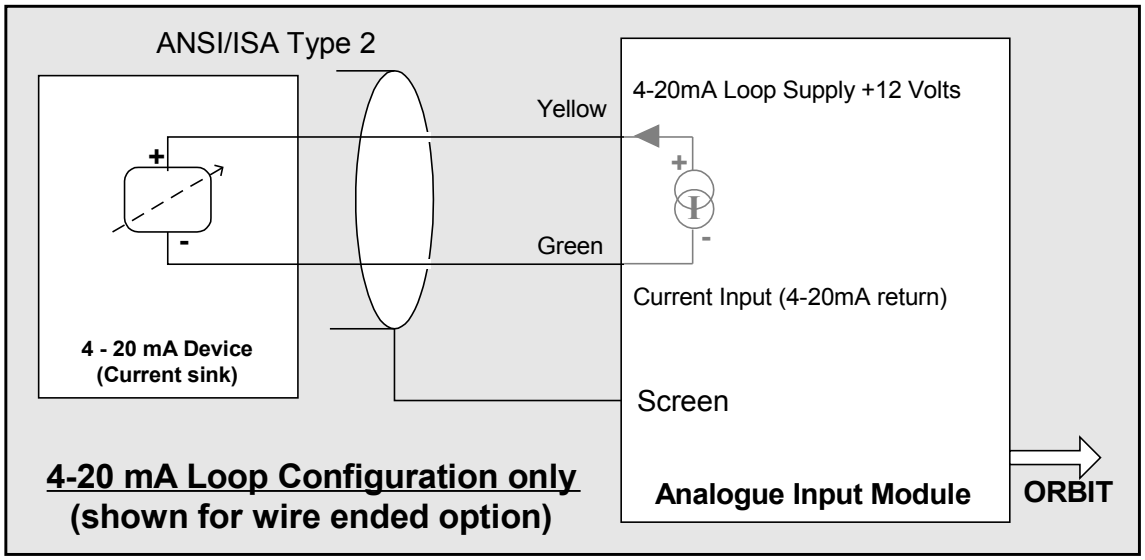
| | |
|---|---|
| Energizing | See Module Power Consumption and Environment table |
| Temperature | |
| | |
| Sealing | IP43 |

### 8.2.4 Connection Details Voltage AIM



### 8.2.5 Connection Details Current AIM



## 8.3 TECHNICAL SPECIFICATION PT100 AIM.

### 8.3.1 PT100 AIM relationship between Temperature and Resistance

The PT100 AIM is a special module for use with a PT100 temperature sensor. The PT100 is a widely used sensor in which the resistance varies as a function of temperature. The equation for the PT100 is:-

$R_t=R_0(1+at+Bt^2)$

Where t = temperature in ºC
Rt = resistance at temperature t in Ω
$R_0$ = resistance at 0ºC
A = alpha coefficient 0.391 Ω/ºC
B = beta coefficient $-5.78 \times 10^{-7}$

The beta term is used to correct for non linearity. The exact values used for alpha and beta vary according to the specified operating range. This equation allows temperature to be accurately measured using a resistance measurement. The PT100 AIM is calibrated against a series of precision resistors.

### 8.3.2 PT100 Temperature and Resistance Tolerance Table

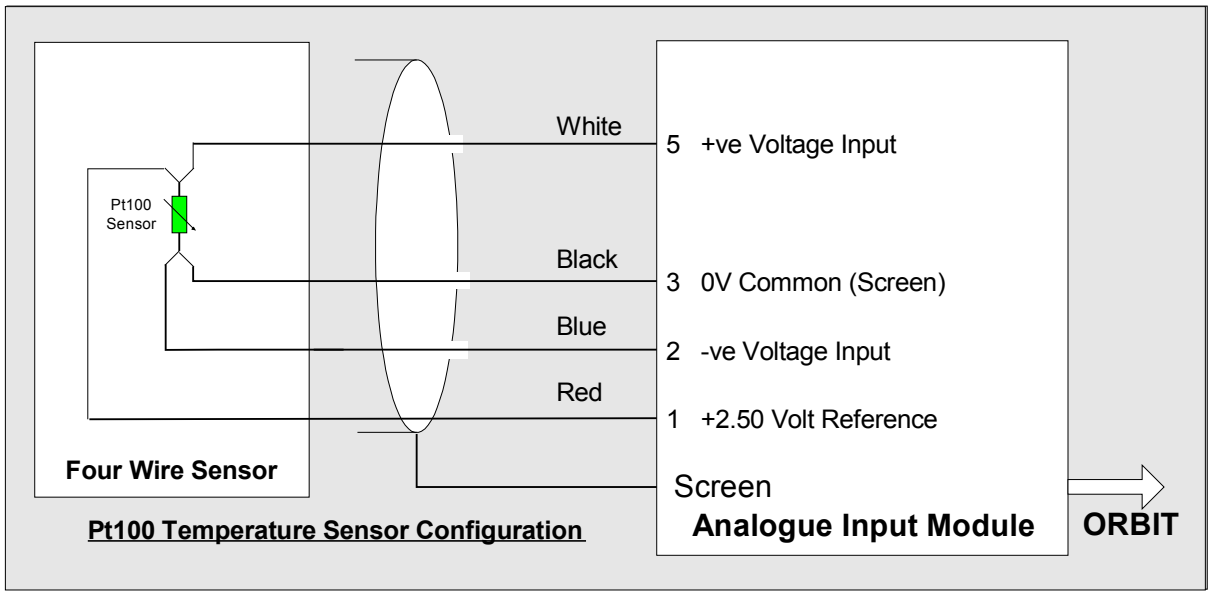
The PT100 sensor itself has a tolerance, there are two types A and B. The following table shows the PT100 sensor tolerance as specified in IEC 751 Standard. The PT100 AIM tolerance can never be better than the tolerance of the PT100 sensor.

| Temperature | Resistance | Tolerance | | | |
|---|---|---|---|---|---|
| | | Class A | | Class B | |
| ºC | Ω | ±ºC | Ω | ±ºC | Ω |
| -200 | 18.52 | 0.55 | 0.24 | 1.3 | 0.56 |
| -100.00 | 60.26 | 0.35 | 0.12 | 0.8 | 0.32 |
| 0.00 | 100.00 | 0.15 | 0.06 | 0.3 | 0.12 |
| 100.00 | 138.51 | 0.35 | 0.13 | 0.8 | 0.30 |
| 200.00 | 175.86 | 0.55 | 0.20 | 1.3 | 0.48 |
| 300.00 | 212.05 | 0.75 | 0.27 | 1.8 | 0.64 |
| 400.00 | 247.09 | 0.95 | 0.33 | 2.3 | 0.79 |
| 500.00 | 280.98 | 1.15 | 0.38 | 2.8 | 0.93 |
| 600.00 | 313.71 | 1.35 | 0.43 | 3.3 | 1.06 |
| 650.00 | 329.64 | 1.45 | 0.46 | 3.6 | 1.13 |
| 700.00 | 345.28 | | | 3.8 | 1.17 |
| 800.00 | 375.70 | | | 4.3 | 1.28 |
| 850.00 | 390.48 | | | 4.6 | 1.34 |

### 8.3.3 AIM PT100 Accuracy

Apart from the tolerance of the PT100 sensor the PT100 AIM accuracy is effected by the connection method. The PT100 AIM is designed to be connected as a four wire connection. If the PT100 AIM is connected in any other way then the accuracy will be compromised. Ensure that the sense wires are connected close to the sensor to avoid unwanted lead effects.

### 8.3.4 Connection Details PT100




**Pt100 Temperature Sensor Configuration**

# 9 ENCODER INPUT MODULE

## 9.1 INTRODUCTION

The Encoder Input Module (EIM) is an Orbit Module which can interface to incremental and rotary encoders with square wave outputs, allowing these sensors to be interfaced into the Orbit Measurement System. Using rotary encoders via the EIM in conjunction with linear measurement sensors allows the Orbit Measurement System to perform part profiling.

## 9.2 TECHNICAL SPECIFICATION

Inputs

| | |
|---|---|
| Input Signal Type | Single ended or differential square waves with open collector or push pull outputs.<br><br>Voltage Range: 0 to 30V Max |
| Differential Input Signal Switching levels | High, VID > 0.2V<br>Low, VID < 0.2V |
| Single Ended Input Switching Voltage | High > 2.4V<br>Low < 1V |
| | |
| Frequency | 1.2MHz Max<br>Using higher frequency may make the EIM read incorrectly |

Operational Modes

The EIM can be used like any other Orbit Module where a controller reads from the EIM on command. The EIM can form part of a dynamic collection. The EIM can be handed control and provide synchronization for a dynamic collection.

See the Orbit3 Software Manual for further information on using the EIM.

Programmable Parameters

| | |
|---|---|
| Inputs | Single Ended<br>Differential |
| Interpolation | X1 (default)<br>X2<br>X4 |
| | Count AB |
| | Count DIR |
| Reference Pulse | Do nothing<br><br>Reset counter on reference pulse<br><br>Preset counter on reference Pulse<br><br>Reset counter on first reference pulse only<br><br>Preset counter on first reference pulse only<br><br>Reset counter on first reference pulse only and enable, Synch, Transmit and Holdoff functions<br><br>Preset counter on first reference pulse only and enable, Synch, Transmit and Holdoff functions |
| | |

Please see the Orbit Measurement System Software Manual for further information on using the EIM.

Power consumption and environment is detailed in ORBIT3 MODULES POWER REQUIREMENTS AND ENVIRONMENT

## 9.3 EIM CONNECTION DETAILS

### 9.3.1 Basic EIM Wired Ended Connections

| Wire Colour | Description |
|---|---|
| Blue | +5V (out to encoder) 300mA Max |
| Pink or White | A- |
| Red | A+ |
| Green | B- |
| Yellow | B+ |
| Orange | Ref- |
| Brown | Ref+ |
| Grey | Error |
| Black | 0V |

Count Direction, the EIM will provide an increasing count when A leads B

### 9.3.2 Quadrature Mode

| | | | |
|---|---|---|---|
| Input Type – Single Ended | | Input Type Differential | |
| Encoder Signal | EIM Input | Encoder Signal | EIM Input |
| A Out | A+ | A+ Out | A+ |
| No Connection | A- | A- Out | A- |
| B Out | B+ | B+ Out | B+ |
| No Connection | B- | B- Out | B- |
| Ref Out | Ref+ | Ref Out | Ref+ |
| No Connection | Ref- | Ref- Out | Ref- |

Note
The inputs to the EIM that have No Connection must be left unconnected. If the encoder has no reference output the EIM Ref+ input can be connected to the EIM 0V to improve noise immunity.

### 9.3.3 CountAB Mode Up

| Input Type – Single Ended | | Input Type Differential | |
|---|---|---|---|
| Encoder Signal | EIM Input | Encoder Signal | EIM Input |
| Signal to Count(Low to High) | A+ | Signal to Count(Low to High) | A+ |
| No Connection | A- | Inverted A+ Signal | A- |
| EIM +5V | B+ | No Connection | B+ |
| No Connection | B- | EIM 0V | B- |
| EIM 0V | Ref+ | EIM 0V | Ref+ |
| No Connection | Ref- | No Connection | Ref- |

See note under quadrature mode

### 9.3.4 CountAB Mode Down

| Input Type – Single Ended | | Input Type Differential | |
|---|---|---|---|
| Encoder Signal | EIM Input | Encoder Signal | EIM Input |
| EIM +5V | A+ | No Connection | A+ |
| No Connection | A- | EIM 0V | A- |
| Signal to Count(Low to High) | B+ | Signal to Count(Low to High) | B+ |
| No Connection | B- | Inverted B+ | B- |
| EIM 0V | Ref+ | EIM 0V | Ref+ |
| No Connection | Ref- | No Connection | Ref- |

See note under quadrature mode

### 9.3.5 CountDir Mode Up

| Input Type – Single Ended | | Input Type Differential | |
|---|---|---|---|
| Encoder Signal | EIM Input | Encoder Signal | EIM Input |
| Signal to Count(Low to High) | A+ | Signal to Count(Low to High) | A+ |
| No Connection | A- | Inverted A+ | A- |
| EIM 0V | B+ | EIM 0V | B+ |
| No Connection | B- | No Connection | B- |
| EIM 0V | Ref+ | EIM 0V | Ref+ |
| No Connection | Ref- | No Connection | Ref- |

See note under quadrature mode

### 9.3.6 CountDir Mode Down

| Input Type – Single Ended | | Input Type Differential | |
|---|---|---|---|
| Encoder Signal | EIM Input | Encoder Signal | EIM Input |
| Signal to Count(Low to High) | A+ | Signal to Count(Low to High) | A+ |
| No Connection | A- | Inverted A+ | A- |
| EIM +5V | B+ | No Connection | B+ |
| No Connection | B- | EIM 0V | B- |
| EIM 0V | Ref+ | EIM 0V | Ref+ |
| No Connection | Ref- | No Connection | Ref- |

See note under quadrature mode

# 10 DIGIMATIC INTERFACE MODULE

## 10.1 INTRODUCTION

The Digimatic Input (DIM) Module is designed to connect to any Digital gauge with a Digimatic ((code) Output. The connection to the Digital gauge is via a 10 way male connector which will connect to any Mitutoyo Digimatic compatible gauge.

## 10.2 CONNECTIONS

| Pin | Signal | Description | Direction |
|---|---|---|---|
| 1 | GND | Signal Ground | |
| 2 | DATA | Data Output | To DIM |
| 3 | CLOCK | Synchronized Clock Output | To DIM |
| 4 | DATA SW | Gauge Data Switch (if fitted) | To DIM |
| 5 | REQ# | Data Transmission Request | From DIM |
| 6 | Not used | | |
| 7 | Not used | | |
| 8 | Not used | | |
| 9 | Not used | | |
| 10 | Not used | | |

For Power Consumption and Environmental Specification refer to ORBIT3 MODULES POWER REQUIREMENTS AND ENVIRONMENT

Note: Pin4 Data SW is not always available on all gauges.

# 11 DIGITAL INPUT OUTPUT MODULE

## 11.1 INTRODUCTION

The Digital Input Output Module (DIOM) provides an interface between the Orbit® Measurement System and the external world. The DIOM provides 8 discrete signal lines that can be configured as an input or an output. This provides a simple interface to control switches, PLC etc.

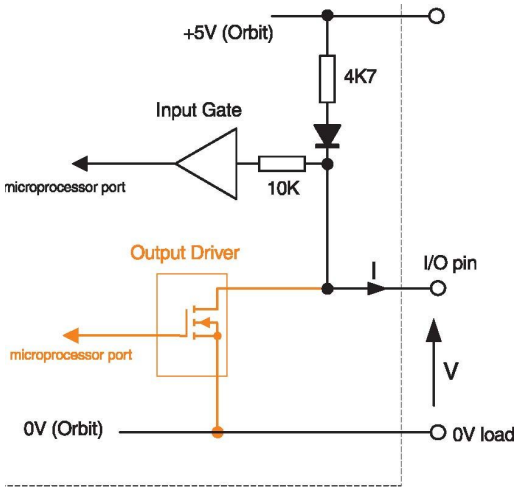
## 11.2 TECHNICAL SPECIFICATION.

For Power Consumption and Environmental Specification refer to ORBIT3 MODULES POWER REQUIREMENTS AND ENVIRONMENT

### 11.2.1 Input Port Specification

The output Port must be set High using the Orbit Preset Command before the port can be used as an input. Please refer to the Orbit Software manual for further details.

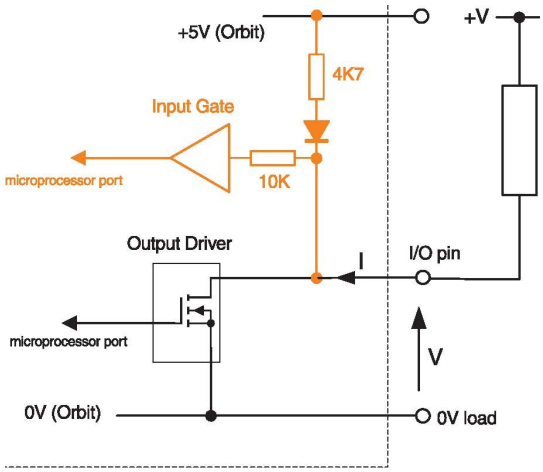
| | |
|---|---|
| Input Port Pull Up Resistor | 4k7 (to Orbit +5V supply) |
| High Switching Voltage | ≥ 3.15V |
| Low Switching Voltage | ≤ 1.35V |
| Maximum input rating | -0.5V to +30V |
| Source current | ≤ 1.mA |




Input Configuration

### 11.2.2 Output Port Specification with External Supply

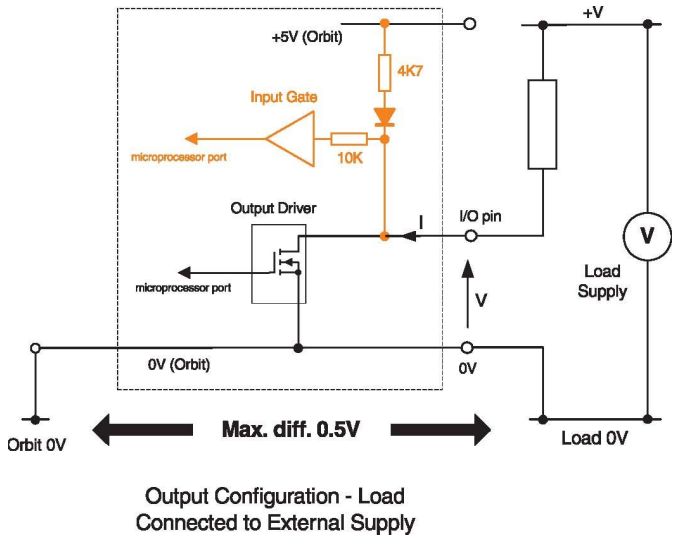
| | |
|---|---|
| Driver Type | Open Drain (requires external Pull UP or load to external supply |
| High Switching Voltage | ≥ 3.15V |
| Low Output Voltage | ≤ 0.2V |
| Maximum output rating | -0.5V to +30V |
| Sink current | ≤ 50.mA |




Output Configuration - Load Connected to External Supply

### 11.2.3 0V connection Rules

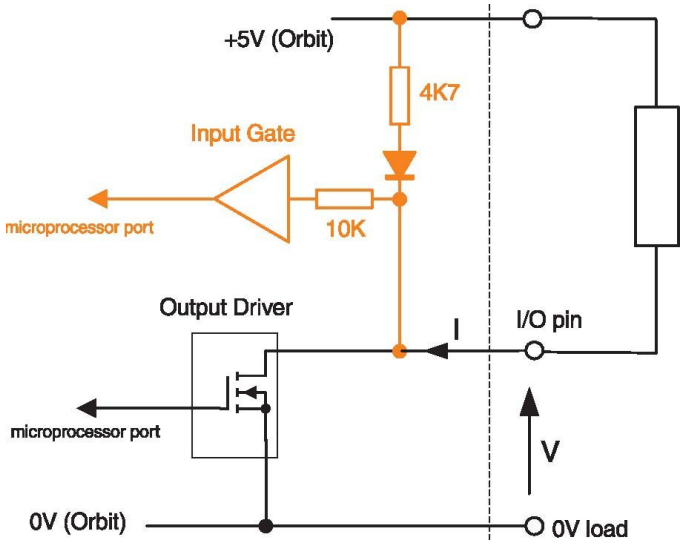
**CAUTION**: Return current for load connected to an external supply MUST be returned to an external supply 0V (load 0V). Failure to do this may damage the DIOM.



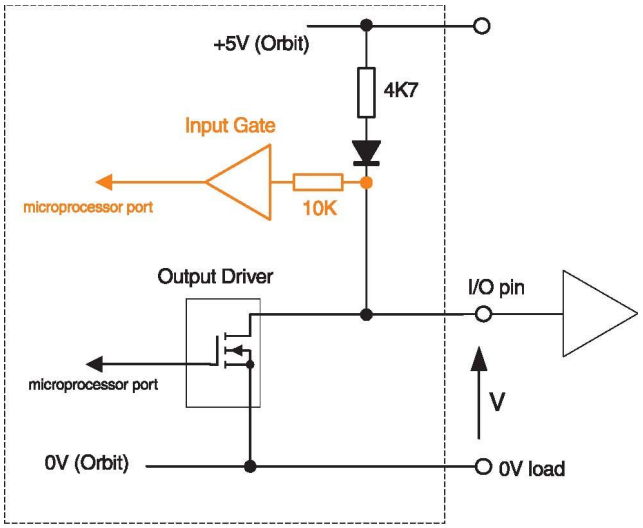

Output Configuration - Load Connected to External Supply

### 11.2.4 Output Port Specification Driver Using Orbit Supply

The Orbit +5V supply (PIN13 DIOM) . This can supply a MAXIMUM of 50mA which can be used for low power switching of external devices. DO NOT EXCEED 50mA or the DIOM can be damaged.



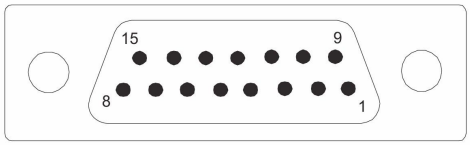
### 11.2.5 Logic Port Specification

| | | |
|---|---|---|
| Input Port Pull Up Resistor | 4k7 (to Orbit +5V supply) |  Logic Output Configuration |
| Low Switching Voltage | ≤ 0.2V | |
| | | |

## 11.3 CONNECTION DETAILS

The DIOM is supplied with a 15 way D Type Connector

| PIN | I/O |
|---|---|
| 1 | 0 |
| 2 | 1 |
| 3 | 2 |
| 4 | 3 |
| 5 | 4 |
| 6 | 5 |
| 7 | 6 |
| 8 | 7 |
| 9 | 0V |
| 10 | 0V |
| 11 | 0V |
| 12 | 0V |
| 13 | +5V |
| 14 | Not used |
| 15 | Not used |

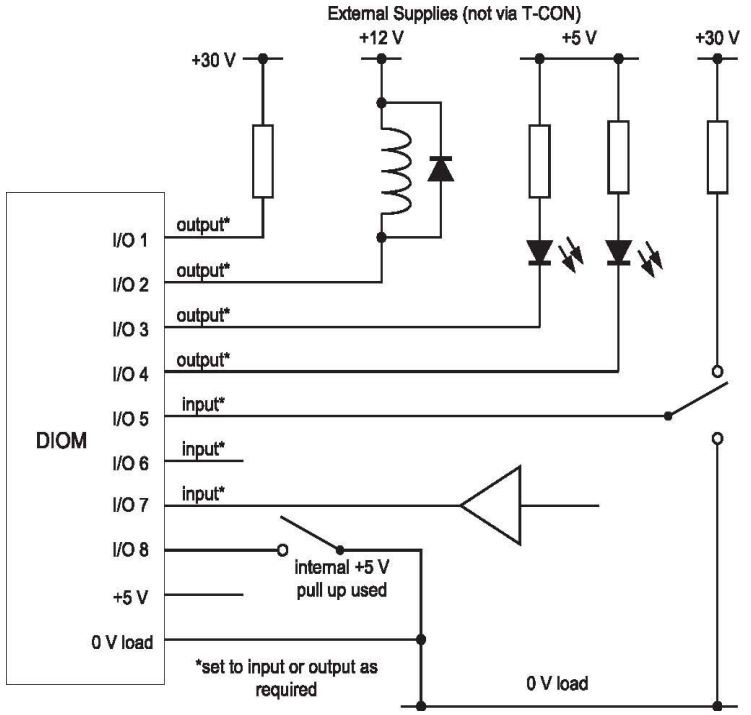


### 11.3.1 DIOM Application

Example of Connection to the DIOM

CAUTION: Inductive loads must be suppressed using diodes

0V load must be connected to supply 0V




Hints and Tips

External switches can sometimes bounce, be disturbed by vibration, harsh electrical environments can cause spikes. All of these can cause an incorrect reading. Taking multiple readings can help with the elimination of spurious results caused by the former.

## 12 REVISION HISTORY

| REVISION | DATE | COMMENTS |
|---|---|---|
| 1 | 22/02/10 | Initial Issue |
| | | |
| | | |
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| | | |
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