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SA100 Digital - Linear & Rotary

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7.0 SA100 Digital - Linear & Rotary / Appendix A
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1.0 TECHNICAL SPECIFICATION

Construction: 1.5mmn sheet metal

Dimensions:
- Height: 72mm (2.835")
- Width: 144mm (5.878")
- Depth: 70mm (2.756")
- Weight: 0.487Kg (1.07lbs)

Operating Voltage: 12 - 27 VDC ±10%

Supply Voltage Fluctuation: Within operating voltage range

Maximum Power Consumption: 6 watts

Operating Temperature: 0 to 45°C

Storage Temperature: -20 to 60°C

Inputs:
- Single channel quadrature

Input Configuration:
- (See DIP switches on rear of DRO)

- Differential Encoder Input (A, /A, B, /B, RM, /RM)
- Single Ended Encoder Input (A, B, RM)

Environmental Conditions:
- Indoor use, IP20
- Pollution degree 2 in accordance with IEC664

Relative Humidity:
- Maximum 80% for temperatures up to 31°C
- Decreasing linearly to 33% at 45°C

EMC Compliance:
- BS EN 50081-2 Electromagnetic Compatibility
  Generic Emission Standard - Industrial Environment
- BS EN 50082-2 Electromagnetic Compatibility
  Generic Immunity Standard - Industrial Environment

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2.0 CONNECTION

INPUTS

**Encoder Input (9-way D)**

<table>
<thead>
<tr>
<th>Pin No.</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>N/C (or 0V)</td>
</tr>
<tr>
<td>2</td>
<td>Channel A</td>
</tr>
<tr>
<td>3</td>
<td>Channel /A</td>
</tr>
<tr>
<td>4</td>
<td>Channel B</td>
</tr>
<tr>
<td>5</td>
<td>Channel /B</td>
</tr>
<tr>
<td>6</td>
<td>0V</td>
</tr>
<tr>
<td>7</td>
<td>+5V</td>
</tr>
<tr>
<td>8</td>
<td>Channel RM</td>
</tr>
<tr>
<td>9</td>
<td>Channel /RM</td>
</tr>
</tbody>
</table>

**Auxiliary Input (15-way D)**

<table>
<thead>
<tr>
<th>Pin No.</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Reserved</td>
</tr>
<tr>
<td>2</td>
<td>0V</td>
</tr>
<tr>
<td>3</td>
<td>Reserved</td>
</tr>
<tr>
<td>4</td>
<td>Reserved</td>
</tr>
<tr>
<td>5</td>
<td>Reserved</td>
</tr>
<tr>
<td>6</td>
<td>Reserved</td>
</tr>
<tr>
<td>7</td>
<td>+5V DC</td>
</tr>
<tr>
<td>8</td>
<td>+5V DC</td>
</tr>
<tr>
<td>9</td>
<td>0V</td>
</tr>
<tr>
<td>10</td>
<td>Reserved</td>
</tr>
<tr>
<td>11</td>
<td>Reserved</td>
</tr>
<tr>
<td>12</td>
<td>Remote Index</td>
</tr>
<tr>
<td>13</td>
<td>Reserved</td>
</tr>
<tr>
<td>14</td>
<td>Reserved</td>
</tr>
<tr>
<td>15</td>
<td>0V</td>
</tr>
</tbody>
</table>

**WARNING!** DO NOT CONNECT THE UNIT DIRECTLY TO THE MAINS POWER SUPPLY.
3.0 INSTALLATION

An optional installation kit allowing for either desk, or panel mounting is available. (Part Number: DSAKIT)

Desktop or support mounting arm

Panel Mounting

<table>
<thead>
<tr>
<th>ITEM</th>
<th>DESCRIPTION</th>
<th>QTY</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>M4 S/C SPRING WASHER</td>
<td>2</td>
</tr>
<tr>
<td>6</td>
<td>M4 FLAT WASHER</td>
<td>2</td>
</tr>
<tr>
<td>5</td>
<td>SPACE WASHER</td>
<td>2</td>
</tr>
<tr>
<td>4</td>
<td>M4x12 CAP HD SCREW</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>KNOB</td>
<td>2</td>
</tr>
<tr>
<td>2</td>
<td>BRACKET</td>
<td>2</td>
</tr>
<tr>
<td>1</td>
<td>BRACKET</td>
<td>1</td>
</tr>
</tbody>
</table>

Installation SA100 Linear & Rotary

Newall Measurement Systems
4.0 INTRODUCTION

The **SA100** range of digital readouts, DRO, offers the very best in functional versatility backed by Newall’s famous robustness and quality guarantee.

Two versions are available:

- The **SA100 Digital** for applications where a linear displacement is to be measured.

- The **SA100-R Digital**. This DRO offers a range of functions specifically targeted at rotary applications, be they measured by a shaft encoder or a radius tape.

Please ensure that you have the correct SA100 Digital model for your application.

This manual covers both versions of the **SA100**. Please refer to the relevant section for details of operation.
4.1 NORMAL OPERATION

SA100

1. Pressing [abs/inc] key toggles between absolute and incremental mode. LED's on the [abs/inc] key indicate current operating mode.

2. Pressing [in/mm] key toggles between inch and millimetre mode. LED's on the [in/mm] key indicate current operating mode.

3. Pressing this key zeroes the current absolute or incremental position, as indicated by the LED's on the [abs/inc] key.

4. Reference To find a scale reference marker press the [0] key and, whilst held, press the [abs/inc] key.

SA100-R

1. Pressing [abs/inc] key toggles between absolute and incremental mode. LED's on the [abs/inc] key indicate current operating mode.

2. A) Rollover (± 360°)

   Pressing the [angle] key toggles between positive and negative arcs. The LED's on the [angle] key indicates the current operating mode.

   e.g. Positive angle = (Negative angle + 360°)

   i.e. +270° = -90°

   B) Continuous count (±)

   Pressing the [angle] key toggles between the continuous measured count and the radial, arc, position. i.e. the continuous measured position minus the number of whole 360° rotations. The LED's on the [angle] key indicates the current operating mode.

   e.g. Continuous measured angle = 973°

   i.e. Radial angle = 973° - (2 x 360°) = 253°

3. Pressing this key zeroes the current absolute or incremental position, as indicated by the LED's on the [abs/inc] key.

4. Reference To find a scale reference marker depress the [0°] key and, whilst held, press the [abs/inc] key.
4.2 REFERENCE OPERATION

**Note:** This function only works with encoders that provide an index marker output signal. However, an externally generated reference (e.g., a limit switch) can also be used. Please refer to APPENDIX A for more details.

This feature allows for any given axes to be referenced to a datum position. The index marker pulse, from the encoder, is used to generate a signal that informs the DRO that the reader head has reached its datum position. Index pulses generally appear in one of two forms depending on the type of encoder connected. These can either be periodic, say 20mm, or single action. Generally, when a scale has a single action index marker this is located at the centre of travel.

1. Enter Reference mode using the \([0] + [\text{abs/ inc}]\) key combination.

2. The display will show ‘\(\text{REF} \)’, The \(\text{SA100} \) will continue to show this until a reference marker is found **or** the referencing operation is aborted using the \([\text{in/mm}]\) key.

**A) For Periodic Index pulses**

Position the encoder such that it lies between the datum index marker and the next index marker position. (Say, within +/-15mm for a 20mm index period).

3. Move the axis towards the datum index position. Once the index marker has been triggered the axis will start to count. The axis position is now referenced to that datum position. Both absolute and incremental axis values will be loaded with the value assigned to \(\text{REF LOAD}\) during Set-Up. This value may be positive, negative or zero.

**B) For Single Shot Index marker**

3. Move the axis towards the datum index position. Once the index pulse has been triggered the axis will start to count. The axis position is now referenced to that datum position. Both absolute and incremental axis values will be loaded with the value assigned to \(\text{REF LOAD}\) during Set-Up. This value may be positive, negative or zero.

**Note 1:** The axis will start to count from the value defined in Set-Up for ‘\(\text{REF LOAD}\)’.

**Note 2:** Refer to the encoder manual for specification information relating to its Index marker(s).

**Note 3** If the operation is aborted the axis position (absolute or incremental) will be zeroed. i.e. any previous position information will be lost.
### 4.3 Editing a Floating Point Value

On entry into a parameter edit mode (by the `[abs/inc]` key) the existing parameter value is displayed. A cursor is shown either as a flashing '_', (underscore), if the digit position is blank or as a flashing version of the digit at the current position.

The three SA100 keys are used to edit a value as follows:

<table>
<thead>
<tr>
<th>SA100</th>
<th>SA100-R</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>[0]</td>
<td>[0^]</td>
<td>Used as &quot;ENTER&quot; when the required value has been keyed in.</td>
</tr>
<tr>
<td>[abs/inc]</td>
<td>[abs/inc]</td>
<td>Used to scroll the digit at the current position through the values: -, 0, 1...9</td>
</tr>
<tr>
<td>[in/mm]</td>
<td>[angle]</td>
<td>Used to move the cursor through the numeric digits to be edited.</td>
</tr>
</tbody>
</table>
5.1 SET-UP MODE SA100 (Linear)

Entry into Set-Up mode is achieved by holding down the [abs/inc] key during normal operation and then pressing the [in/mm] key momentarily.

Once in SET-UP mode the following menu items are accessible:

To move through the available Set-Up options press the [in/mm] key.

- **SET-UP**: Press the [0] key to save changes and exit Set-Up
- **AR**: Axis resolution
  - Toggle through available options using the [abs/inc] key
- **DR**: Display resolution (mm)
  - Toggle through available options using [abs/inc] key
- **DIR**: Direction (0 or 1)
  - Toggle using [abs/inc] key to change sense of direction
- **FEN**: Fail Enable (ON or OFF)
  - Toggle using [abs/inc] key (OFF = Ignore, ON = Sensor fail detected)
- **REF LOAD**: Axis Load value used during referencing operation.
  - Pressing [abs/inc] key allows editing.
- **LIN ERR**: Linear Error Comp (0.900000 to 1.100000).
  - Pressing [abs/inc] key allows editing.
- **SF**: Scale Factor (0.001 to 99999.999).
  - Pressing [abs/inc] key allows editing.
- **SFT**: Scale Factor Type (0 or 1)
  - Toggle using [abs/inc] key (0 = Multiply, 1 = Divide)

When the parameters have been configured, return to the SET-UP menu item and press [0] to return to normal operation mode.

**Tip.**
Check that the [in/mm] keys LED’s are in the desired mode prior to entering Set-Up. The unit of measurement (inch or mm) used during Set-Up is defined by the current operating display mode.
5.2 **AR - AXIS RESOLUTION**

Axis resolution is the distance moved between successive encoder output edges.

**Example:**
A 5-micron resolution would be derived from an encoder having a 20-micron period. i.e. a times four multiplier will be applied.

![Diagram showing encoder output edges and resolution](image)

**Procedure:**
- From Set-Up select ‘AR’.
- Use the [abs/inc] key to toggle through the available axis resolutions.

5.3 **DR - DISPLAYED RESOLUTION**

The displayed resolution does not have to coincide with the selected Axis Resolution. It can not however be selected to be of a higher resolution than that defined for Axis Resolution.

**Procedure:**
- From Set-Up select ‘DR’.
- Use the [abs/inc] key to toggle through the available display resolutions.

**Example:**
If the Axis Resolution is set to 1 micron.

Using the [abs/inc] key to toggle through 0.001, 0.002, 0.005 and 0.01.
Consequently, the displayed resolution can be selected to be 1, 2, 5 or 10 microns.
5.4 DIR - DIRECTION

Direction allows the operator to change the positive direction of travel of the reader head.

Procedure:
- From Set-Up select 'DIR'.
- Use the [abs/inc] key to toggle the setting value between 0 and 1.

Example:
If the current setting is 0 and the travel is positive from right to left then changing the setting to 1 will reverse the direction to measure positive from left to right.

5.5 FEN - HEAD FAIL DETECTION

The SA100 has the facility to detect if the attached encoder has become disconnected, sustained severe cable damage or with some encoders, electronic failure.

Mode of Operation
The detection mechanism monitors the incoming signals from the encoder to look for an illegal combination of input levels.

<table>
<thead>
<tr>
<th>A</th>
<th>B</th>
<th>RM</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>L</td>
<td>L</td>
<td>H</td>
<td>SIG FAIL</td>
</tr>
<tr>
<td>L</td>
<td>H</td>
<td>X</td>
<td>OK</td>
</tr>
<tr>
<td>H</td>
<td>L</td>
<td>X</td>
<td>OK</td>
</tr>
<tr>
<td>X</td>
<td>X</td>
<td>L</td>
<td>OK</td>
</tr>
</tbody>
</table>

X = don’t care state i.e. can be either High (H) or Low (L).

If the signal fails or the encoder becomes disconnected, then the illegal input combination is generated internally within the SA100. The display will then show 'SIG FAIL'. If you are able to correct the fault then pressing the [0] key will reset the display. If the 'SIG FAIL' message continues to be displayed after pressing the [0] key then the fault has not been corrected.

Disabling the Head Failure Detection
Procedure:
- From Set-Up select 'FEN'.
- Use the [abs/inc] key to toggle the setting value between OFF (disable) and ON (enable).
5.6 REF LOAD - REFERENCE LOAD

This function allows for a pre-programmed value to be loaded into the axis counter, as a start value, when the ‘Reference’ function is implemented.

Procedure:

- From Set-Up select ‘REF LOAD’.
- Use the [abs/inc] and [in/mm] keys to enter the desired Reference load value, as described earlier.

Example:

The SA100 is configured with a 1m travel, linear scale with a single reference, index, marker located at its centre. The operator wishes to set the datum, zero point, to the leftmost end of the scale.

Scale length = 1000mm
Index marker located mid scale = 500mm
Hence, REF LOAD = 500
5.7 LIN ERR - LINEAR ERROR COMPENSATION

Linear Error Compensation allows the operator to apply a constant correction factor to the axis measurement before it is displayed. Linear error may occur if the axis of the machine is not perfectly parallel to the scale (cosine error) or if the machine is moving in an arc (Abbé errors). The cause of this may be:

- Machine wear
- Deflection of the machine due to an uneven weight
- Misalignment of the scale due to poor installation

The Linear Error Compensation Factor is expressed as a multiplier, (0.900000 to 1.100000), that is applied to the measured distance prior being displayed. A factor of 1.000000 indicates that no compensation is being applied.

\[
\text{Compensation Factor} = \frac{\text{True or standard distance moved}}{\text{Measured Distance}}
\]

\[\text{i.e.} \quad \text{Measured distance} \times 1.000000 = \text{Measured distance}\]

In order to calculate the required Compensation Factor, from normal operation with no compensation applied:

Procedure:

- Move the machine to the zero position of the standard against which the axis is to be compared.
- Zero the display using the [0] key.
- Move the machine a known distance as defined by the standard and record the measured distance as displayed on the SA100.
- Calculate the Compensation Factor using:

\[
\text{Compensation Factor} = \frac{\text{True or standard distance moved}}{\text{Measured Distance}}
\]

- Enter Set-Up and select 'LIN ERR'
- Enter the calculated Compensation Factor as described previously
5.8 SF & SFT - SCALE FACTOR

Ignoring all offsets and rounding to display resolution, the displayed value on the **SA100** (millimetre mode) is a result of the following calculation:

If \( \text{SFT} \) (Scale Factor Type) = 0

\[
\text{DISTANCE} = \text{EDGE_COUNT} \times \text{AXIS_RESOLUTION} \times \text{LINEAR_COMP} \times \text{SCALE_FACTOR}
\]

If \( \text{SFT} \) (Scale Factor Type) = 1

\[
\text{DISTANCE} = \text{EDGE_COUNT} \times \text{AXIS_RESOLUTION} \times \text{LINEAR_COMP} / \text{SCALE_FACTOR}
\]

Where:

- **EDGE_COUNT** = number of edges from encoder from zero position
- **AXIS_RESOLUTION** = 0.0001, 0.0002, 0.0005, 0.001, 0.002, 0.005 or 0.01 mm
- **LINEAR_COMP** = error compensation factor in range 0.900000 to 1.100000 (Default = 1.000000)
- **SCALE_FACTOR** = 0.001 to 99999.999 (Default = 1.000)

**Example:**

A linear encoder is connected to a RAM that is being used to pump measured amounts of a fluid. The diameter of the RAM is 10cm and the display is required to show how many litres of fluid are being displaced for a given stroke.

**Working in mm mode:**

\[
\text{Volume displaced (mm}^3\text{)} = \frac{\pi \times D^2 \times \text{Stroke}}{4}
\]

Where:
- \( D \) is the RAM diameter in mm
- \( \text{Stroke} \) is in mm

Recalling that there are \( 1000cm^3 \), \( (=1,000,000mm^3) \), in 1 litre (SI definition) gives:

\[
\text{Scale Factor (to show Litres)} = \frac{\pi \times D^2 \times \text{Stroke}}{4 \times 1,000,000} = \frac{\pi \times 10,000}{4,000,000}
\]

\[
\text{Scale Factor (to show Litres)} = 0.00785
\]

This is very small and close to the 3dp limit for an applied Scale Factor. Consequently, instead of multiplying by such a small factor we can divide by its inverse.

\[
\text{Scale Factor (to show Litres)} = \frac{1}{0.00785} = 127.324
\]

The Scale Factor Type (SFT) is \( 1 \) as the value calculated is to act as a divisor.

i.e. The display will show \( (S / 127.324) \) (where \( S \) = measured distance/stroke in mm)
6.0 SA100- R Digital ROTARY DIGITAL READOUT

6.1 SET-UP MODE SA100-R (Rotary)

Entry into Set-Up mode is achieved by holding down the [abs/inc] key during normal operation and then pressing the [angle] key momentarily.

Once in SET-UP mode the following menu items are accessible:

To move through the available Set-Up options press the [angle] key.

- **SET UP-R**: Press the [0°] key to save changes and exit Set-Up.

- **TYP**: Alter using [abs/inc] key to select between AUTO, TAPE or ROTY

- **CONFIG**: Used self calibrate system and automatically set some system parameters. Only appears for type AUTO

- **AR**: Axis resolution (mm). Only appears for type TAPE
  Toggle through options (0.0001 through 0.01) using [abs/inc] key.

- **CPR**: Counts per revolution. Only appears for type ROTY
  Pressing [abs/inc] key allows editing.

- **DR**: Display resolution in decimal places.
  Toggle through options (0.0001 through 0.01) using [abs/inc] key.

- **DIR**: Direction (0 or 1).
  Toggle using [abs/inc] key to change sense of direction.

- **FEN**: Fail Enable (ON or OFF).
  Toggle using [abs/inc] key (OFF = Ignore, ON = Sensor fail detected).

- **REF LOAD**: Axis Load value used during REF operation.
  Pressing [abs/inc] key allows editing.

- **ANGLE**: Set mode of display (CT or RL)
  Toggle using [abs/inc] key (CT - Continuous, RL = ±360° Rollover)

- **DISP**: Set unit mode of display (-.-.- or DEC).
  Toggle using [abs/inc] key (DEC = Decimal Degrees, -.-.-DMS).

- **RADIUS**: Load value (mm) used in calculation of angle when in angle mode.
  Pressing [abs/inc] key allows editing. Only appears for type tape

- **ANG ERR**: Angular Error Comp (0.900000 to 1.100000).
  Pressing [abs/inc] key allows editing. Only appears for type tape

- **G RATIO**: Gear Ratio (0.001 to 99999.999). Only appears for type ROTY
  Pressing [abs/inc] key allows editing
6.2 SET-UP MENU STRUCTURE SA100-R

Figure 1. Set-Up Menu Structure
6.3  CONFIG - AUTOMATIC CALIBRATION

This feature allows systems to be configured even when fundamental elements of the system are unknown.

**CONFIG** will automatically allow for systems where:

- Axis resolution
- Rotary of angular movement
- Counts per revolution
- Gearing
- Table radius

...are unknown, to be accurately configured.

**Procedure:**

- From 'TYPE' select 'AUTO'
- Display will show 'CONFIG'
- Press the [abs/ inc] key to enter automated calibration
- Display will show 'SET 0'.
- Move the rotary table to a datum, position.
- Press any key
- The display will change to 'ANGLE'
- Press any key to edit the default value of 90 degrees, [0 ] to enter)
- Move the rotary table a known, standard, angle (e.g. 90°)
- This display will show (e.g.) ‘SET 90’
- Press any key
- The display will show either ‘CAL PASS’ or ‘CAL FAIL’
- Press any key
- This display will return to ‘CONFIG’
- If calibration was succesful move onto the next item ‘DR’ using the [angle] key to repeat the ‘CONFIG’ process using [abs/ inc] key.

The automatic calibration procedure is now complete. Set the remaining user parameters as defined in the menu structure.
6.4 AR - AXIS RESOLUTION

Axis resolution is the distance moved between successive encoder output edges.

Example:
A 5-micron resolution would be derived from an encoder having a 20-micron period. i.e. a 4 times four multiplier will be applied.

Procedure:
- From Set-Up select 'AR'.
- Use the [abs/inc] key to toggle through the available axis resolutions.

6.5 DR - DISPLAYED RESOLUTION

The setting defines the decimal places to which an angular position is displayed.

Procedure:
- From Set-Up select 'DR'.
- Use the [abs/inc] key to toggle through the options (0.0001 through to 0.01)

Example 1: Decimal Degrees
The DR setting defines the decimal places and rounding to which the angular position will be displayed if decimal degrees are being displayed

- DR = 0.002
- True angle = 247.3477
- Displayed value = 247.348

Note: If DEGREES . MINUTES . SECONDS are being displayed then no rounding occurs.
### 6.6 DIR - DIRECTION

Direction allows the operator to change the positive direction of travel of the reader head.

**Procedure:**
- From Set-Up select 'DIR'.
- Use the [abs/inc] key to toggle the setting value between 0 and 1.

**Example:**
If the current setting is 0 and the travel is clockwise from right to left then changing the setting to 1 will reverse the direction to measure clockwise from left to right.

### 6.7 FEN - HEAD FAIL DETECTION

The SA100-R has the facility to detect if the attached encoder has become disconnected, sustained severe cable damage or with some encoders, electronic failure.

**Mode of Operation**
The detection mechanism monitors the incoming signals from the encoder to look for an illegal combination of input levels.

<table>
<thead>
<tr>
<th>A</th>
<th>B</th>
<th>RM</th>
<th>STATUS</th>
</tr>
</thead>
<tbody>
<tr>
<td>L</td>
<td>L</td>
<td>H</td>
<td>SIG FAIL</td>
</tr>
<tr>
<td>L</td>
<td>H</td>
<td>X</td>
<td>OK</td>
</tr>
<tr>
<td>H</td>
<td>L</td>
<td>X</td>
<td>OK</td>
</tr>
<tr>
<td>X</td>
<td>X</td>
<td>L</td>
<td>OK</td>
</tr>
</tbody>
</table>

X = don't care state i.e. can be either High (H) or Low (L).

If the signal fails or the encoder becomes disconnected, then the illegal input combination is generated internally within the SA100. The display will then show 'SIG FAIL'. If you are able to correct the fault then pressing the [0] key will reset the display. If the 'SIG FAIL' message continues to be displayed after pressing the [0] key then the fault has not been corrected.

**Disabling the Head Failure Detection**

**Procedure:**
- From Set-Up select 'FEN'.
- Use the [abs/inc] key to toggle the setting value between OFF (disable) and ON (enable).
6.8 REF LOAD - REFERENCE LOAD

This function allows for a pre-programmed value to be loaded into the axis counter, as a start value, when the ‘Reference’ function is implemented.

Procedure:

- From Set-Up select ‘REF LOAD’
- Use the [abs/inc] and [angle] keys to enter the desired Reference load value, as described earlier.

Example:

The SA100-R is configured with an encoder on a rotary indexing table capable of describing a 180° arc and has an index marker at 90°. The operator wishes to set the display to read 90°, not zero, when referencing the system.

Hence,

\[
\text{REF LOAD} = 90.0000 \quad \text{(in decimal degrees)}
\]
Angular Error Compensation allows the operator to apply a constant correction factor to the axis measurement before it is displayed. The function is applied when it is not possible to accurately measure the radius of the rotary table when configuring the system manually.

The Angular Error Compensation Factor is expressed as a multiplier, (0.900000 to 1.100000), that is applied to the measured distance prior to being displayed. A factor of 1.000000 indicates that no compensation is being applied.

\[ \text{Compensation Factor} = \text{Measured Angle} \times 1.000000 = \text{Measured Angle} \]

In order to calculate the required compensation factor, from normal operation with no compensation applied:

**Procedure:**

- Move the machine to the zero position of the standard against which the axis is to be compared (90° square for example).
- Zero the display using the [0°] key.
- Move the machine through a known arc, as defined by the standard, and record the measured angle as displayed on the SA100-R.
- Calculate the Compensation Factor using:

<table>
<thead>
<tr>
<th>Compensation Factor</th>
<th>True or standard arc moved</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Measured arc</td>
</tr>
</tbody>
</table>

- Enter Set-Up and select 'ANG ERR'
- Enter the calculated Compensation Factor as described previously

---

**Notes**

Although this feature is provided to give set-up flexibility, where the radius of the rotary system is not accurately known it is advised that the Auto calibration option be implemented to configure the system.

All measurements will be adjusted, multiplied, according to the Compensation Factor entered. To disable this facility enter a Linear Error Compensation Factor of 1.000000.
6.10 G. RATIO - GEAR RATIO COMPENSATION

Gear Ratio Compensation allows for systems where gearing occurs after the point at which the angular position can be measured.

A factor of 1.000 indicates that no gearing compensation is being applied.

\[ \text{Measured Angle} \times 1.000 = \text{Measured Angle} \]

**Example:**

A system consists of a rotary shaft encoder coupled to a rotary table providing gearing of 1 to 2. In order to display the table angle the G.RATIO must be similarly defined.

\[ \text{i.e. Table angle} = \frac{1}{2} \times \text{that measure at the encoder} \]

Hence:

\[ \text{G.RATIO} = 0.500 \]

6.11 ANGLE - ANGLE DISPLAY MODE

Angle allows the operator to define if the display is to rollover at 360° back to zero or to give a continuous measurement.

**Procedure:**

- From Set-Up select 'ANGLE'
- Use the [abs/inc] key to toggle the setting value between CT (continuous) and RL (360° rollover)

**Example:**

<table>
<thead>
<tr>
<th>ANGLE MODE</th>
<th>True angle</th>
<th>CT</th>
<th>RL</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>650°</td>
<td>650°</td>
<td>290°</td>
</tr>
<tr>
<td></td>
<td>-720°</td>
<td>-720°</td>
<td>0°</td>
</tr>
</tbody>
</table>

/ Note. Although this feature is provided to give set-up flexibility, where the radius of the rotary system is not accurately known it is advised that the Auto calibration option be implemented to configure the system.

/ Note. All measurements will be adjusted, multiplied, according to the Gear ratio factor entered. To disable this facility a G.RATIO of 1.000 must be entered.
6.12 DISP - DISPLAY MODE

This option allows the operator to select what mode of angular position the SA100-R is to display. The two options are Decimal Degrees (DD) and Degrees-Minutes-Seconds (DMS).

<table>
<thead>
<tr>
<th>Display type</th>
<th>DMS</th>
<th>DD DEC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Resolution (max)</td>
<td>1 second</td>
<td>As set by DR</td>
</tr>
<tr>
<td>Example</td>
<td>45.32.12</td>
<td>72.3421</td>
</tr>
</tbody>
</table>

6.13 RADIUS - TABLE RADIUS DEFINITION

This function allows for the entry of the radius of the rotary table to be entered, when angular positions are to be measured and displayed. (For Tape mode only).

Procedure:

- From Set-Up select ‘RADIUS’.
- Use the [abs/inc] and [angle] keys to enter the table radius, as described earlier.

The angle displayed is calculated from the distance moved along the ARC (circumference) and the radius as follows:

$$\text{Angle} = \frac{\text{Distance} \times 360^\circ}{2 \times \pi \times \text{Radius}}$$

6.14 CPR - COUNTS PER REVOLUTION (ROTARY ENCODERS)

This function allows for the implementation of Rotary shaft encoders. This type of encoder is generally in the form of a rotating disc.

The CPR refers to the number of counts, or edges, that the encoder will give for a single revolution. Care should be taken in the same way as with the setting of Axis resolution as the SA100-R automatically applies a x4 multiplier to the quadrature-input signals.

The information on the counts per revolution can be found in the encoder manufactures specification and is also generally marked on the encoder itself.

Procedure:

- From Set-Up select ‘CPR’.
- Use the [abs/inc] and [angle] keys to enter the CPR, as described earlier.
7.0 USE OF AUXILLARY REFERENCE INPUT

Sometimes it may be desirable to use an auxiliary reference marker i.e. one not integrated within an encoder. This could be a precision microswitch at one extreme of travel. With the SA100 (or SA100-R) it is possible to use such a remote switch contact to provide a reference pulse. The wiring arrangement required for this is shown below in Figure 1.

![Figure 1.](image)

It is important that any reference signals (if any) generated by the encoder are not connected to the 9 way encoder input. Instead a remote normally closed switch is wired between pins 2 and 12 of the 15 way auxiliary connector.

5 volt DC power is also available on the 15 way auxiliary connector:

- Pins 2, 9 & 15 on the 15 way are 0V
- Pins 7, 8 on the 15 way are +5V DC (max 100mA)

This 5 volt power can be used to power some solid state limit/proximity switches. However, any device added must replicate the action of a normally closed contact. For this reason simple mechanical switches are recommended. The following schematic shows the index input circuit to aid the selection of a proximity switch, should solid state interfacing be required. The Index(+) input should be normally be held below 2.5 volts. When it rises above this an the index signal is detected. Note maximum input voltages are as per RS422 specifications.

Using the arrangement outlined above does not provide any synchronisation between the encoder A/B signals and the auxiliary reference input. One consequence of this is that the sensor fail detection of the SA100 must be disabled (FEN = OFF) since the A/B/INDEX fail condition could exist whenever an asynchronous reference pulse occurs.
8.0 TROUBLESHOOTING

<table>
<thead>
<tr>
<th>SYMPTOM</th>
<th>SOLUTIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nothing happens when the unit is switched</td>
<td>Check unit is correctly connected to a working power source.</td>
</tr>
<tr>
<td>The unit is working but shows erratic readings.</td>
<td>This suggests a poor earth (ground) connection. Ensure the earth (ground) connection is installed. Ensure that the DIP switch settings at the rear of the unit are correctly set for the encoder type, single-ended or differential. See Section 1.0.</td>
</tr>
<tr>
<td>The ‘SIG FAIL’ message is displayed.</td>
<td>There are two possible explanations for this message.</td>
</tr>
<tr>
<td>The displayed measurement is not correct.</td>
<td>There are four possible explanations for this effect.</td>
</tr>
<tr>
<td>The unit appears to count in the wrong ‘DIR’</td>
<td>Check the Direction configuration setting direction in Set-Up. See Section 5.4 or 6.6 (depending on model).</td>
</tr>
</tbody>
</table>

8.0 CLEANING

Disconnect the unit from the power supply before cleaning.

It is recommended that the unit be wiped over with a lint free cloth with a non corrosive/abrasive cleaning fluid.

Do not use compressed air.
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