

Technical Information

Sensors

# MCX104A DC Microsyn Level Sensor



**Revision history***Table of revisions*

<b>Date</b>	<b>Changed</b>	<b>Rev</b>
November 2015	Converted to Danfoss layout	0202
February 2013	Environments table: Operating and temperature ratings	0201
July 2012	Ordering number corrected	0200
April 2011	Ordering Information	0100
December 2010	Added PLUS+1 Compliant logo	0003
November 2010	Typo	0002
October 2010	Corrected input voltage to 5 to 8 Vdc	0001
October 2010	Replaces BLN-95-8996	0000

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**Technical Information    MCX104A DC Microsyn Level Sensor**

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## Technical Information    MCX104A DC Microsyn Level Sensor

### Overview

### Description

The MCX104A DC Microsyn Level Sensor electromagnetically measures the deviation of the sensor and its mount from a gravity reference. The reference is an oil damped pendulous mass having freedom of movement in one plane about a fixed center point.

The sensor can be used as a component in a system requiring a reference for control with respect to gravity. It is ideal for use on mobile equipment where a surface must be finished to a required level with respect to gravity.

In typical use, the sensor is connected to a controller, which controls a hydraulic control valve such as a KVF servovalve. If an off-level surface is required, an adjustable setpoint reference can be used, providing up to a  $\pm 10\%$  slope reference.

### Features

- Modular design. Compact unit can be mounted on any vertical surface.
- Totally enclosed in a rugged cast aluminum housing.
- Easy to wire. Connections between controller and sensor are made through MS connectors.
- Excellent sensitivity. The shaft supporting the pendulous mass and the rotor of the microsyn is mounted on ball bearings for smooth, low-friction rotation.
- Oil damped to ignore extraneous vibration.
- DC input and output voltages designed for analog and microcontroller interface.

### Ordering information

#### Reference

Part number	Supply voltage	Body style	Connector	Oil fill
1030040	5 to 8 Vdc	Cast aluminum housing	6 pin MS	3000 cs
11011863	5 to 8 Vdc	Cast aluminum housing	6 pin MS	5000 cs

#### Remote Slope Setpoint (if necessary)

Part Number	Description
MCQ101B1012	Hand-held digital remote setpoint. Required if off-level surface. Provides adjustable setpoint reference (up to $\pm 10\%$ ).

#### Related Product

Part Number	Description
KW01026 cable assembly	Braided (not foil) shield cable with a minimum of 75% shielding.
KW01009 cable assembly	Standard unshielded.

Cables are two to ten feet retractable, completely assembled with a six position straight socket terminal plug connected to each end, and on one end there is a cap and chain.

To ensure avoiding the harmful effects of EMI/RFI use KW01026 shield cable assembly. See [Wiring](#) on page 9.

**Overview**
**Theory of operation**

The MCX104A accepts a regulated 5 to 8 Vdc from a controller and converts it to 3.8 kHz ac. The ac excitation is applied to the primary of four transformers mounted 90° from each other in the sensor housing, see *Rotor-stator relationship*, below.

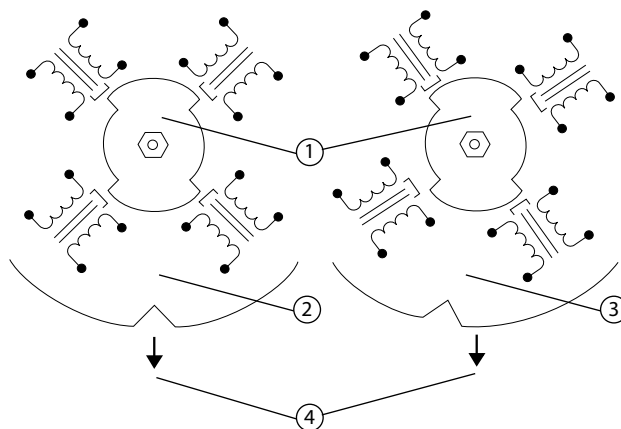
The rotor of the microsyn is made of permeable material and is attached to a ball bearing-mounted shaft. The stator, consisting of the four transformers, is mounted on the outer housing of the sensor. Secondaries of the coils, 180° apart, are wired in series.

Rotor position, with respect to the stator, determines the number of flux linkages between primary and secondary of each coil. The voltages induced in the secondaries are summed so that the output is proportional to the magnitude of the deviation from the gravity reference. Phase indicates the direction of rotation.

At null, an equal amount of the magnetically permeable material of the rotor is in the magnetic field of each coil. As the stator and housing rotates from null, more magnetically permeable material is introduced into the magnetic field of one set of two coils and some material is removed from the magnetic field of the other set of coils. The material displacement results in a higher voltage output from the secondaries of the two coil set with the greater amount of magnetically permeable material in its magnetic field. The displacement also results in a lower voltage output from the other two coil set.

The output signal from the secondaries is demodulated to a nominal range of 2 to 6 Vdc at 8 Vdc excitation and fed back to the controller.

*Rotar-stator relationship*



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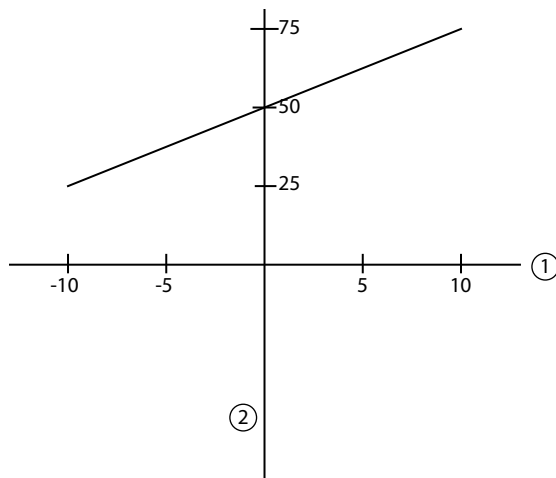
- 1 Rotor
- 2 Slope sensor at null
- 3 Slope sensor 10° from null
- 4 Gravity reference

**Technical data**
**Electrical**

<b>Input voltage</b>	5 to 8 Vdc (positive to Pin A, negative to Pin C)
<b>Power consumption</b>	0.8 watts, maximum
<b>Output voltage</b>	25% of input to 75% of input from -10% to +10% slope
<b>Range</b>	10% slope from vertical, beyond $\pm 10\%$ range, output is undefined
<b>Accuracy (linearity)</b>	$\pm 0.3\%$ slope from $\pm 10\%$ slope
<b>Resolution</b>	Infinite
<b>Short circuit protection</b>	Output lead may be shorted to (+) or (-) input without damage to the device
<b>Repeatability (hysteresis)</b>	0.04% slope, maximum, when brought to the same position from (+) and (-) 10% slope
<b>Step function response</b>	0.42 s to reach 63% of rated output with 3000 centistoke oil
<b>Phasing</b>	When the sensor is rotated clockwise from null, as viewed from the closed end of the cast housing, output (Pin B positive, Pin C negative) will decrease.

The device is ratiometric; at a constant slope, an increased input voltage will result in an increased output voltage (and vice versa). See following *Output voltage versus slope*.

*Output voltage versus slope*



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- 1    Slope (%)  
      (of input voltage)
- 2    Output Voltage (%)  
      (from the MCX104A)

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**Technical Information    MCX104A DC Microsyn Level Sensor**


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**Technical data**
**Environmental**

<b>Operation temperature rating</b>	- 18° to 77° C (0° to 170° F)
<b>Storage temperature rating</b>	- 40° to 77° C (- 40° to 170° F)
<b>Temperature stability</b>	Null shift of ± 0.35% slope maximum; referred to 27° C (80° F)
<b>Vibration (Two part vibration test designed for mobile equipment controls)</b>	Withstands cycling test performed on each of the three major axes: Cycling from 5 to 2000 Hz for a period of one hour (if four resonant points) to three hours (if no resonant point). Withstands resonant dwell for one million cycles for each of the four most severe resonant points on each of the three major axes.
<b>Shock (Three shocks in both directions of the three mutually perpendicular axes for a total of 18 shocks)</b>	50 g per 11 ms
<b>EMI/RFI*</b>	20 V per meter between 14 KHz and 1 Ghz 100 V per meter over the ranges: 24 to 51 Mhz 148 to 175 Mhz 445 to 517 Mhz 798 to 875 Mhz

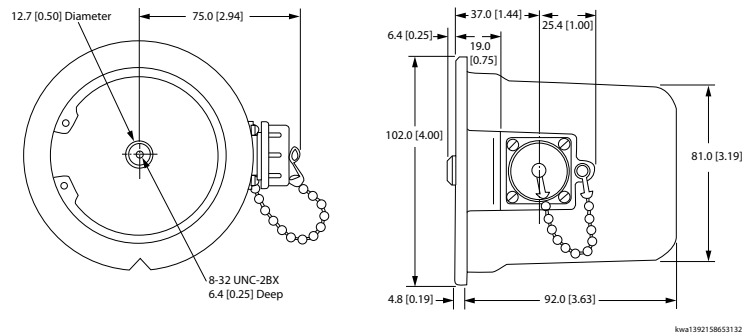
\* All EMI/RFI specifications subject to shielded cabling. See [Wiring](#) on page 9.

Installation

Dimensions

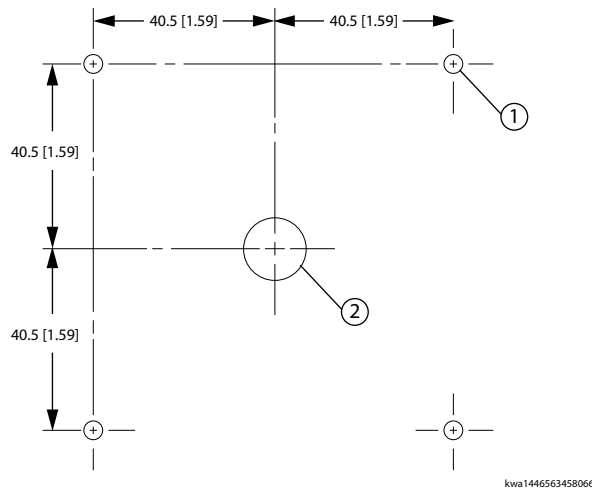
**MCX104A mounting dimensions**

millimeters [inches]



**MCX104A mounting holes**

Mounting holes locations



- 1 Four 8-32 UNC-2B screw holes
- 2 19/32 inch drill bit size pilot hole

**Mounting**

1. Determine the location on any convenient vertical surface.
2. Reference mounting hole locations,
  - a) Drill and tap four #8/32 UNC-2B holes.
  - b) Drill a 15.1 mm [0.59 in] pilot hole at the center of the four holes.
3. When the notch in the flange of the sensor is at the bottom, the sensor is approximately at null. If enough clearance exists above the sensor, install the two bottom cleats, leaving the screws loose enough to get the flange beneath the cleat. The cleats and screws are provided with the sensor.
  - a) Slide the flange of the sensor beneath these two cleats and install the other two.
  - b) Tighten the four cleats so the sensor is snug but can still be turned by hand for final leveling or sloping.



**Installation**
**Wiring**

EMI/RFI will be present in varying degrees in any environment that has static electricity, power lines, radio equipment, solenoid switching, etc. To avoid the harmful effects of EMI/RFI, use KW01026 braided (not foil) shield cable with a minimum of 75% shielding. Terminate the shield at both ends to the connector shell with the length short as possible. See [Ordering information](#) on page 4, related product.

Standard unshielded cables can be ordered from Danfoss. KW01009, a two foot coiled cable extending to ten feet is available, which is completely assembled with mating MS connectors for ease of installation. See [Ordering information](#) on page 4, related product.

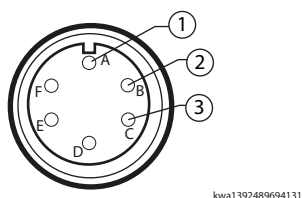
All electrical connections are made to the sensor through a 6 pin MS connector.

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[Reverse power polarity may damage the sensor.](#)

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6 pin MS mating connector



kwa1392489694131

- |          |         |
|----------|---------|
| <b>1</b> | + Power |
| <b>2</b> | Output  |
| <b>3</b> | Ground  |

**Final leveling**

After all wiring has been completed, only minor adjustment is needed to bring the sensor to null:

1. Raise or lower the machine to level.
2. Slowly turn the sensor until the output voltage (Pin B to C) equals one half the supply voltage.

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[With 8 Vdc input, the device will be nulled with 4 Vdc output.](#)

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3. Tighten the cleats so that the sensor is secured.

**Troubleshooting**

The MCX104A will provide extended trouble free operation and should not need servicing under normal operating conditions. Be sure the sensor is malfunctioning before replacing it:

1. Check if one of the two MS connectors at either the controller or the sensor are loose.
2. Check wiring. Inspect the coil cord along its entire length for a cut or evidence of pinching.
3. Check if mounting cleats have loosened from excessive vibration.
4. If a replacement sensor is available, attach it. With the notch in the flange down, rotate the replacement sensor a few degrees side-to-side and observe operation.

If operation appears normal, replace the original sensor.







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