RIEKER inc.

User Programmable
Digital CANopen
Current 0..24mA
Voltage 0..10V
Open Collector Switch
Dual & Single Axis
Up to 360º

2018

Flex™ H6MM CANopen User Guide

Sensor Specifications, Installation, & Wiring

Flex™ H6MM-CANopen User Guide

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Sensor Description

The H6MM-CANOPEN Flex™ Multi-Mount inclinometer provides highly accurate, dual axis inclination over a range of ±180°. These sensors incorporate MEMS accelerometers referenced to gravity with integrated temperature compensation over the full industrial operating range of -40° to +85°C for absolute accuracy. It can be user-configured to mount either horizontally or vertically.

The H6MM-CANOPEN has a digital CANopen output CiA (CAN in Automation) certified to DS-301 and DSP-410 for inclinometers. It also includes LSS (Layer Setting Services) for baud rate and node ID changes. It can be used to measure the angle of both axes, as well as configure the various digital parameters of the sensor.

The H6MM-CANOPEN additionally provides two continuous, current outputs. These outputs are set to 4mA and 20mA with an angle range of ±180°.

Updates & Revision History

The information in this guide may be subject to change. Please visit https://www.riekerinc.com/find-product/h6/h6mm-documents for latest version of this document.

TABLE 1: REVISION HISTORY		
REV	**DATE**	**DESCRIPTION**
-	7/1/2019	Initial Release

Sensor Specifications

INPUT PARAMETERS	
SUPPLY VOLTAGE	+11..36 VDC Non-Regulated
SUPPLY CURRENT[1]	22mA @ 24VDC (Digital Output only)
	30mA nominal @ 24VDC (Analog Output - no load)
	75mA max @ 24VDC (Analog and Digital Outputs enabled)
	85mA max @ 12VDC (Analog and Digital Outputs enabled)
ANALOG MEASURING RANGE	±180°
DIGITAL MEASURING RANGE	±180°
INPUT PROTECTION	Reverse Polarity, ESD & Surge Protected
ABSOLUTE ACCURACY OVER FULL OPERATING TEMPERATURE	
RANGE: ±180°	±0.1º typical, ±0.2º absolute max
RESOLUTION	0.05º
RESPONSE TIME	1Hz (Optional from 4Hz to 0.3Hz)
CANOPEN DIGITAL OUTPUT PARAMETERS	
CERTIFICATION	CiA201903-301V42/303-0233. V4.2
OUTPUT TYPE	CANopen Half Duplex (2-wire) per CiA DS-301
INCLINATION OUTPUT	Per CiA DSP-410
BAUD RATE	Default 500Kbps (Configurable from 125K to 1M via LSS)
NODE ID	Default 5 (Configurable via LSS)
FUNCTIONS	TPDO (polled, cyclic, synchronized), parameterization per SDO and object registers, SYNC Consumer, EMCY Producer, Heartbeat Producer
TEMPERATURE RANGES	
OPERATING TEMPERATURE	-40ºF..+185ºF (-40ºC..+85ºC)
STORAGE TEMPERATURE	-49ºF..+194ºF (-45ºC..+90ºC)
MECHANICAL CHARACTERISTICS	
HOUSING	Aluminum, IP68, All-weather, Submersible
WEIGHT	18.6 oz. (525 Grams)
MOUNTING HOLES	Accept #8 or M4.5 screws (See Dimensional Drawing)
MOUNTING PLANE	Flat Horizontal or Vertical Surface
OUTLINE DIMENSIONS	4.34” x 3.26” x 1.8” [110mm x 82.8mm x 45.7mm]
ELECTRICAL CONNECTION	See Electrical Connection Drawing

Notes:

1. Supply Current varies depending on outputs connected. Digital output only assumes analog output section is always active however current loop is not connected.

H6MM-CANOPEN Installation and Wiring

Note: The H6MM allows the end user to select between horizontal and vertical mounting positions via object 4011h. The factory default mounting position is horizontal, lid up.

1. On the mounting plane, prepare surface with three tapped holes 3.815" [96.9mm] apart for #9 mounting screws. NOTE that the single hole on side with the two slots is not meant to be used for mounting
2. Mount inclinometer to mounting plane using #9 mounting screws.

FIGURE 1: **H6MM-CANOPEN Dimensions and Mounting (Inches [Mm])**

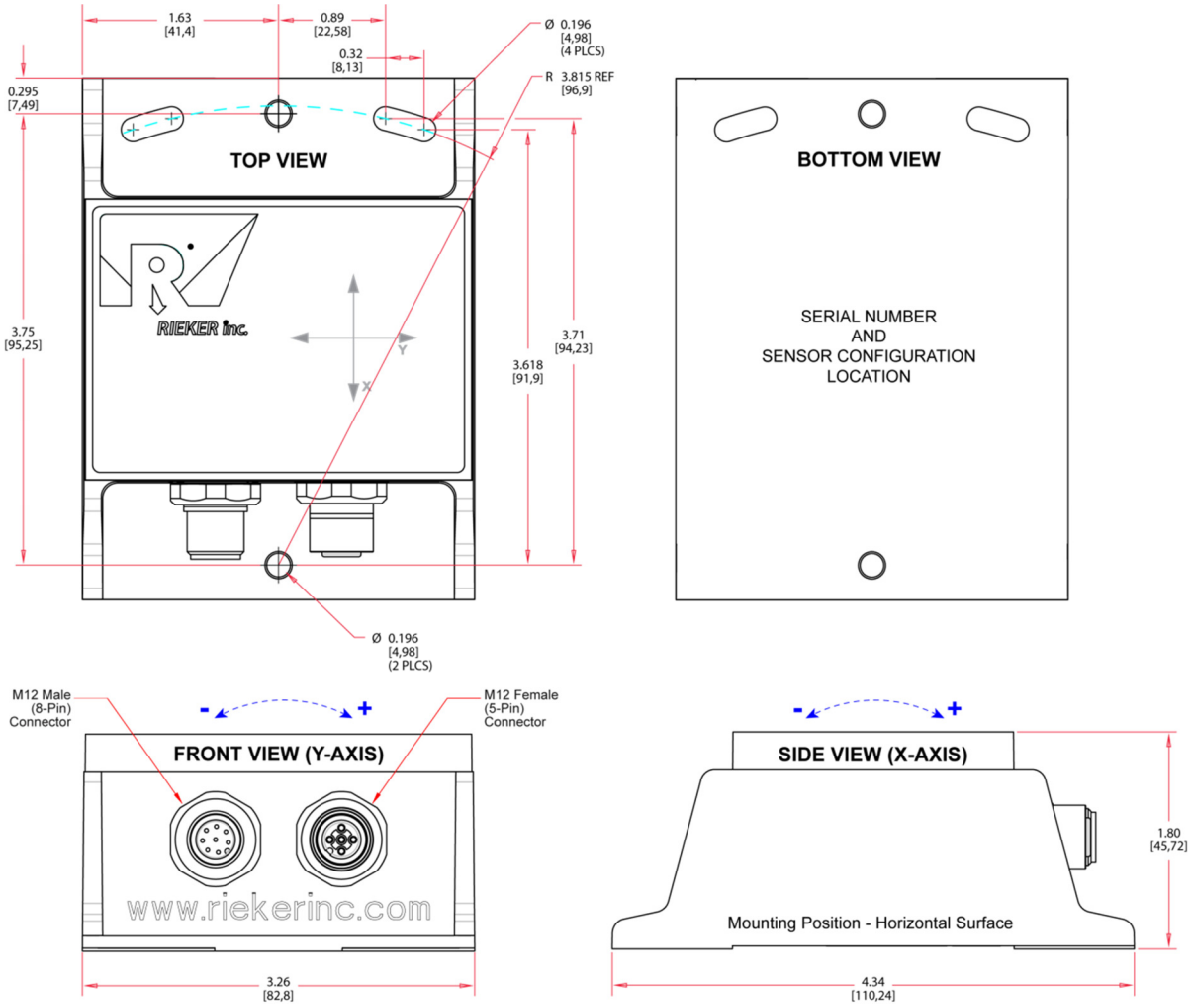
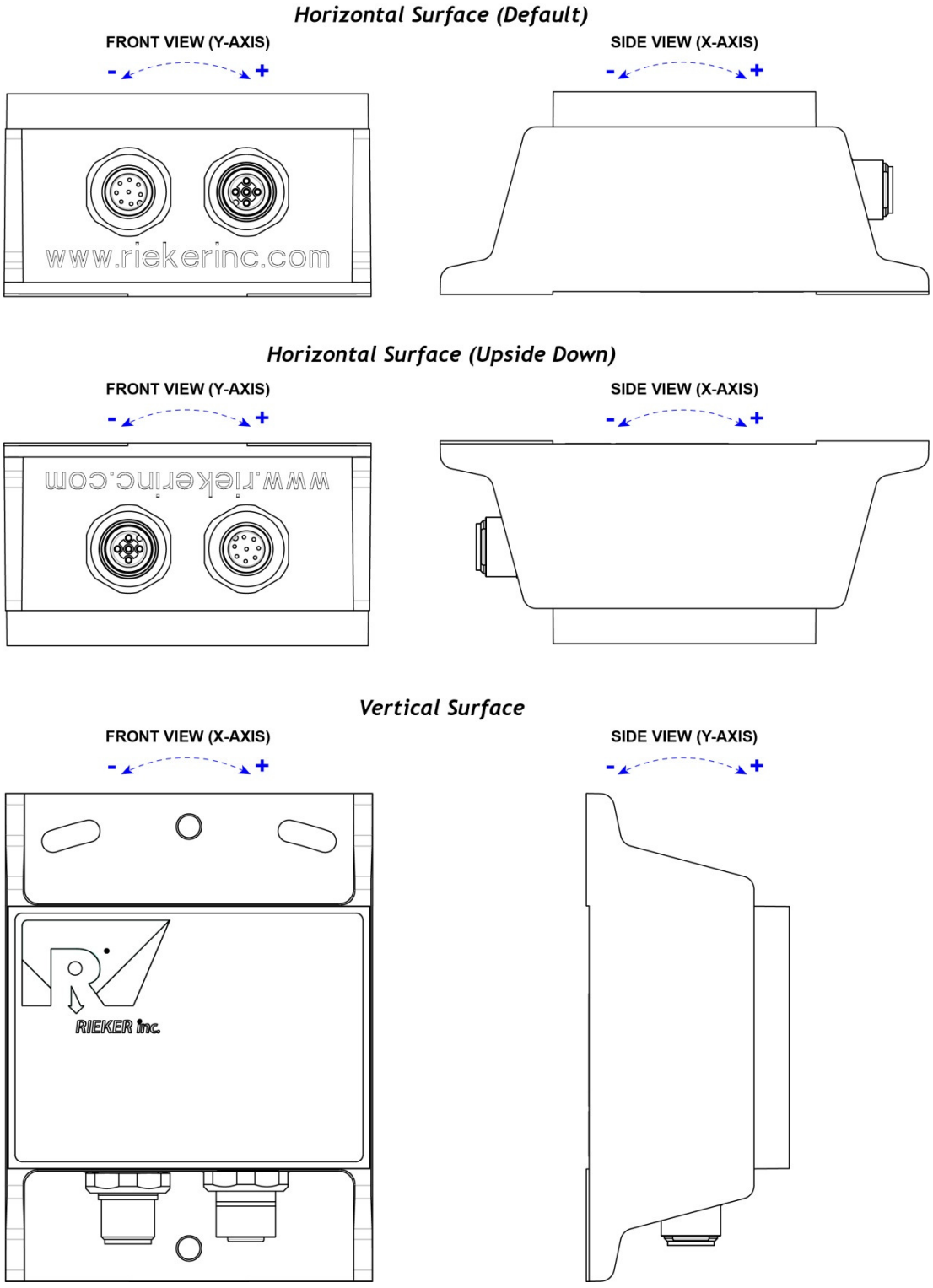


FIGURE 2: **Mounting Positions**



Horizontal Mount Axis Orientations

As shown in the top drawing of *Figure 2*, the 0° orientation for a horizontal mount H6MM-CANOPEN is a desktop level position.

- For the X-axis, looking at the unit from the side with the connector facing to the right, a clockwise rotation from the zero position is considered positive and a counter-clockwise rotation from the zero position is considered negative.
- For the Y-axis, looking at the unit from the front with the connector facing towards you, a clockwise rotation from the zero position is considered positive and a counter-clockwise rotation from the zero position is considered negative.

Vertical Mount Axis Orientations

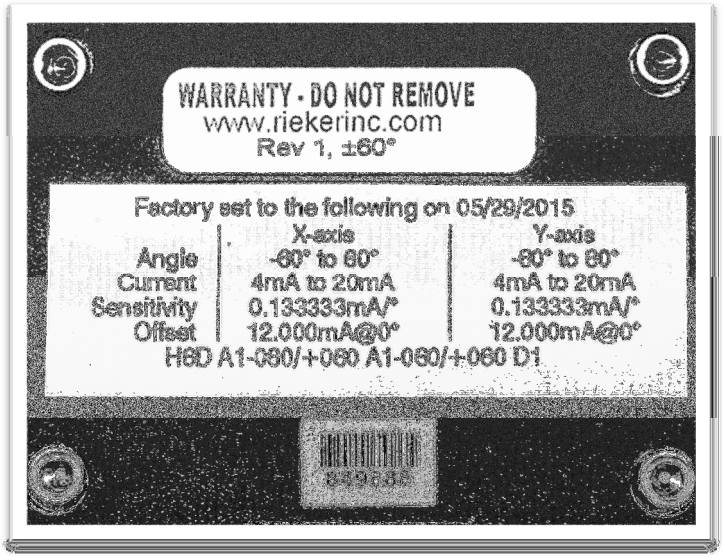
As shown in the bottom drawing of *Figure 2*, the 0° orientation for a vertical mount H6MM-CANOPEN is with the connector facing down.

- For the X-axis, looking at the unit from the top with the connector facing down, a clockwise rotation from the zero position is considered positive and a counter-clockwise rotation from the zero position is considered negative.
- For the Y-axis, looking at the unit from the side with the top facing to the right and the connector facing down, a clockwise rotation from the zero position is considered positive and a counter-clockwise rotation from the zero position is considered negative.

FIGURE 3: **Example of Serial Number and Factory Default Configuration Label**

NOTE: Important information about your sensor is llocated on the bottom of the H6MM-CANOPEN sensor:

- Warranty Label
- Factory Configured Defaults
- Serial Number



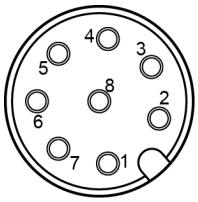
Sample shown is for information purposes only.

H6MM-CANOPEN Connector Wiring Tables

TABLE 2: H6MM-CANOPEN MALE 8-PIN INPUT CONNECTOR WIRING		
PIN	**FUNCTION**	**TERMINATION**
1	SUPPLY VOLTAGE +11.. +36VDC	WHITE
2	POWER / SIGNAL COMMON	BROWN
3	CAN HI	GREEN
4	CAN LO	YELLOW
5	NO CONNECTION	GRAY
6	ANALOG OUTPUT 1 (DEFAULT: X AXIS)	PINK
7	ANALOG OUTPUT 2 (DEFAULT: Y AXIS)	BLUE
8	NO CONNECTION	RED

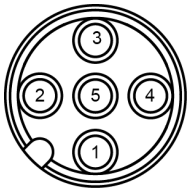
NOTES:

- The front and back of the connector may not have any pin markings in the actual connector. The user will need to look at the front-side keyway (see drawing) to determine pin outs.
- The termination wire colors reference the cable sold by Rieker.



M12 (male 8-pin)
Pin Assignment
FRONT VIEW

TABLE 3: H6MM-CANOPEN FEMALE 5-PIN DIGITAL OUTPUT DAISY CHAIN CONNECTOR WIRING	
PIN	**FUNCTION**
1	NO CONNECTION
2	SUPPLY VOLTAGE +11..+36VDC
3	POWER COMMON
4	CAN HI
5	CAN LO



M12 (female 5-pin)
Pin Assignment
FRONT VIEW

NOTE: The H6MM-CANOPEN Sensor's Chassis Ground is NOT the same as the signal ground for the current output return. The current output return must be connected to the POWER/SIGNAL COMMON (pin 2).

H6MM-CANOPEN Bus Wiring Configurations

When using the digital output, the H6MM-CANOPEN sensor can be connected as a single sensor or can be connected to other sensors in a bus configuration. The following figures show three possible configurations for using the CANopen output.

FIGURE 4: **Single H6MM-CANOPEN Sensor**

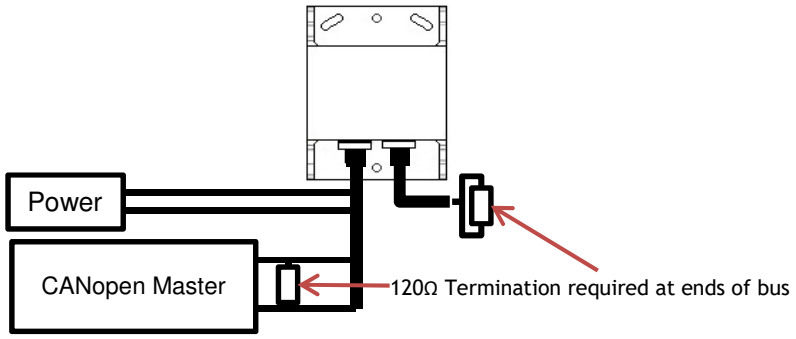


FIGURE 5: **Multiple Daisy-Chain H6MM-CANOPEN Sensors**

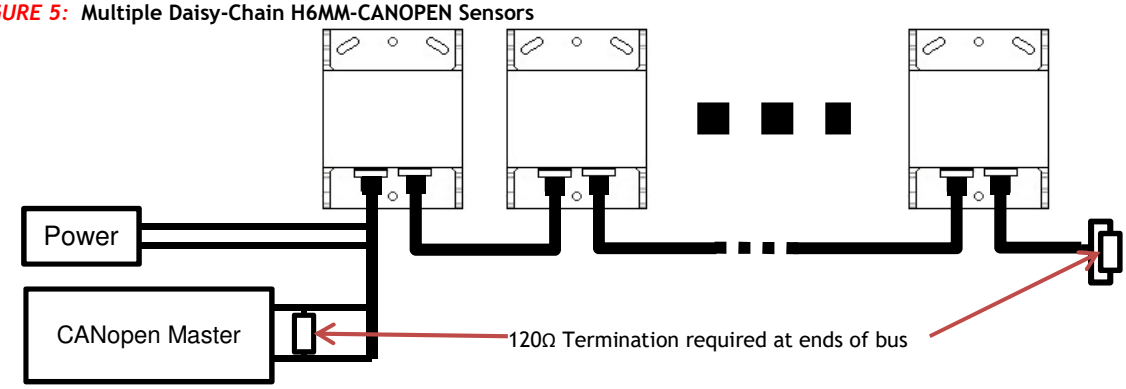


FIGURE 6: **Multiple Multi-Drop H6MM-CANOPEN Sensors**

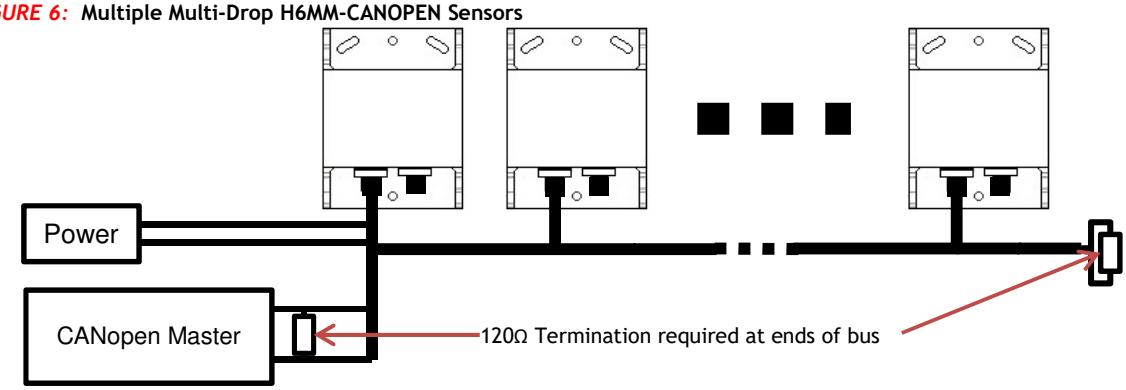
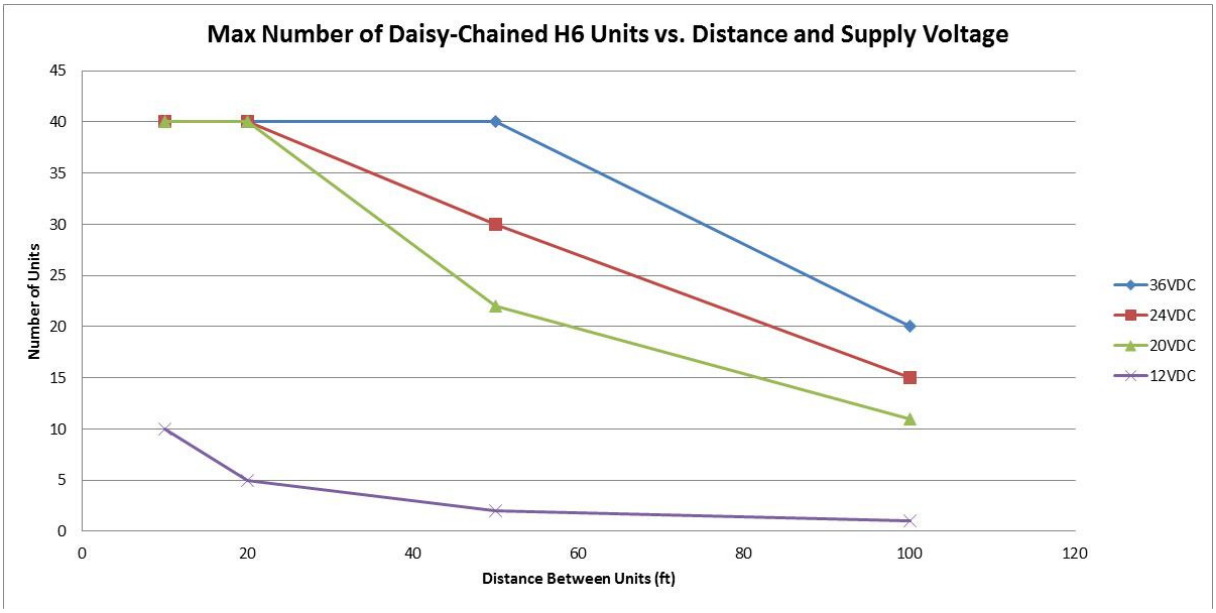


FIGURE 7: **Max Number of Daisy Chain H6MM-CANOPENs Graph**



NOTE: This graph is based on 22AWG wire as the daisy-chain between sensors. Also note that by using a multi-drop configuration, additional sensors may be added, up to a maximum of 60 units due to bus loading.

Analog Outputs

The H6MM-CANOPEN inclinometer comes with two, continuous, current outputs that have been factory set to 4-20mA, ±180°. For user-configurable analog (current, voltage, and switch) outputs without CANOpen, consider the H6MM.

NOTE: Consult the factory for CANopen models that include user-configurable analog (current, voltage, and switch) outputs.

CAUTION: The Flex™ series of sensors are manufactured to allow end user adjustments of the analog and digital output parameters. Purchaser assumes the responsibility of ensuring that the settings are appropriate for their specific application. IN NO EVENT WILL RIEKER BE LIABLE FOR CONSEQUENTIAL OR INCIDENTAL DAMAGES OF ANY KIND.

Sensitivity & Zero Angle Calculation

The output sensitivity is calculated as follows: $\frac{[Max\ Analog - Min\ Analog]}{[Max\ Angle - Min\ Angle]}$. For the H6MM-CANOPEN with a ±180° range and a 4 to 20mA output:

- Sensitivity = $\frac{(20mA-4mA)}{180°-(-180°)} = \frac{16mA}{360°} = 0.0444\ ^{mA}/_{°}$
- Zero Degree Angle Output = $12mA$

Current Output Wiring Diagrams and Connection Procedures

1. Connect the power (PIN 1) to an 11-36VDC supply and the ground (PIN 2) to the supply ground/common.
2. Connect the corresponding output (PIN 6 for output 1, PIN 7 for output 2) to the positive terminal of the measurement device, and the sensor ground (PIN 2) to the negative terminal/common of the measurement device.

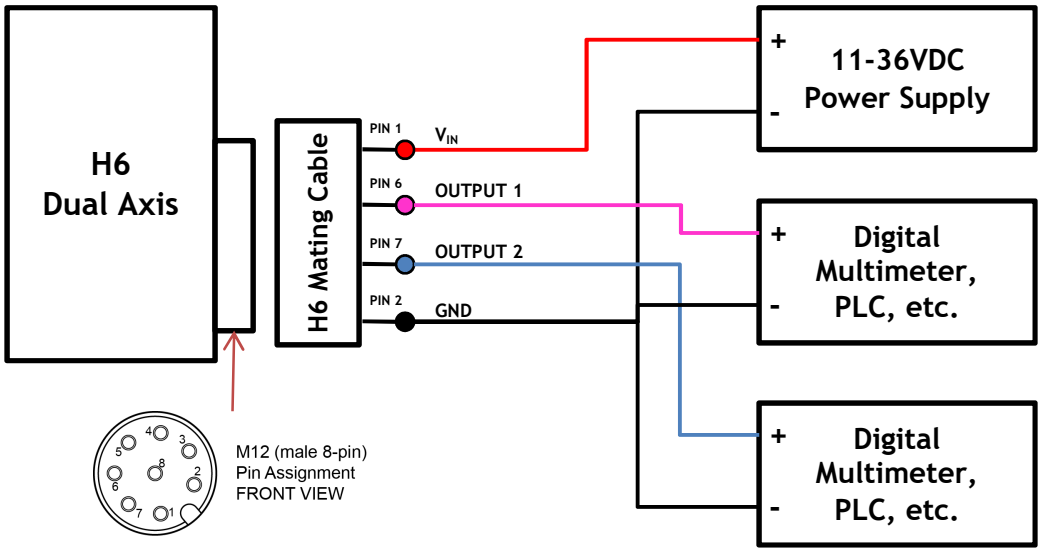
NOTE: Current outputs will not work using chassis ground. Unit ground (PIN 2) must be used.

3. To convert the current to a voltage output select an appropriate load resistor (Rsense) based on the equation defined in Table 4: H6MM-CANOPEN Current Sense

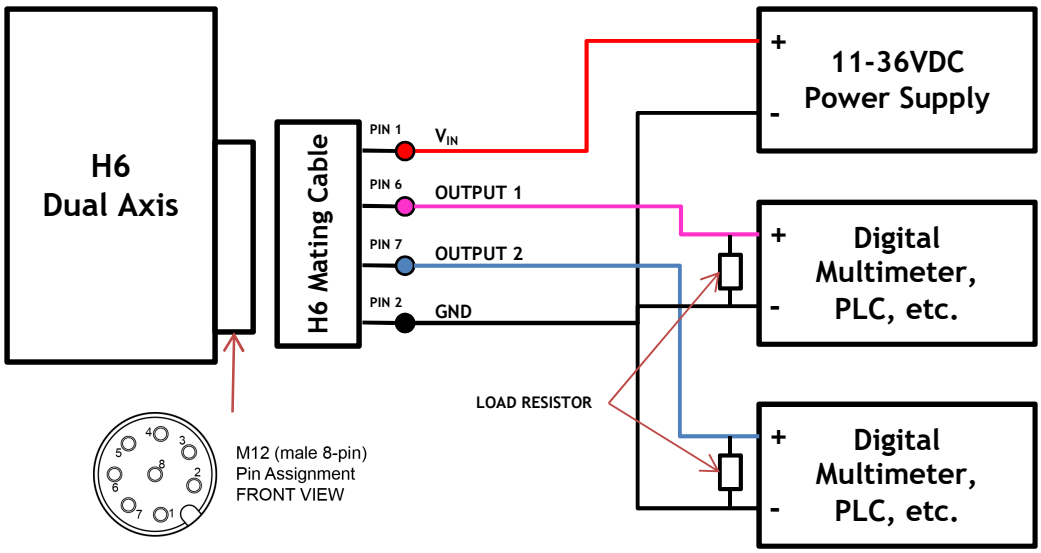
TABLE 4: H6MM-CANOPEN CURRENT SENSE

R_{sense} is dependent upon supply voltage and cable/wire resistance. Ensure the following equation is met: $R_{sense} \leq \frac{V_{supply} - 2.5}{0.020} - R_{wire}$	QUICK REFERENCE	
	SUPPLY VOLTAGE	**SENSE RESISTOR**
	12V	200-350 OHMS
	24V	200-1000 OHMS
	28V	200-1000 OHMS

FIGURE 8: CURRENT WIRING DIAGRAMS



- H6MM-CANOPEN Current Output Measurement



- H6MM-CANOPEN Current Conversion to Voltage Output Measurement

Digital CANopen Communication

The H6MM-CANOPEN inclinometer comes equipped with a standardized CANopen interface per CiA DS-301 and device profile DSP-410. This communication can be used to read inclination angles from the device. In addition, all measured values and parameters are accessible via the object dictionary and can be stored in non-volatile memory. By default, the H6MM-CANOPEN has a 500kbps baud rate and Node-ID 5. Both can be configured via LSS per CiA DS-305.

The following CANopen functions are available:

- Send Data objects (TPDO1) with two possible operating modes:
  - Cyclic: Send at an interval (using inhibit time)
  - Synchronized: Send after receipt of any number of SYNC commands
- Service Data object (Standard SDO) for read/write of the object dictionary
- Error messages per emergency object (EMCY)
- Heartbeat producer (device health monitoring)
- Storage and reload of all parameters (Store and Load Parameter Field)

CANopen Command Functions

Communication Object

INDEX (Hex)	SUB-INDEX (Hex)	OBJECT	Data Type	Access	Default Value (Hex)
1000	00	Device Type (device profile 410, two axes 16-bit)	UNSIGNED32	RO	0002019A
1001	00	Error Register	UNSIGNED8	RO	00
1002	00	Manufacturer Status Register	UNSIGNED32	RO	00
1003	00	Emergency (Number of Errors)	UNSIGNED8	R/W	0
1003	01	Emergency (Standard Error Field 1)	UNSIGNED32	RO	
1003	02	Emergency (Standard Error Field 2)	UNSIGNED32	RO	
1003	03	Emergency (Standard Error Field 3)	UNSIGNED32	RO	
1003	04	Emergency (Standard Error Field 4)	UNSIGNED32	RO	
1003	06	Emergency (Standard Error Field 6)	UNSIGNED32	RO	
1005	00	COB-ID SYNC	UNSIGNED32	CONST	00000080
1008	00	Manufacturer Device Name	VISIBLE STRING	RO	H6 FLEX

1009	00	Manufacturer Hardware Version	VISIBLE STRING	RO	HW PCB067
100A	00	Manufacturer Software Version	VISIBLE STRING	RO	SW B27*
1014	00	COB-ID EMCY	UNSIGNED32	RO	$NODEID+0x80
1015	00	Inhibit Time Emergency	UNSIGNED16	R/W	0
1017	00	Producer Heartbeat Time	UNSIGNED16	R/W	0
1018	00	Identity Object (number of entries)	UNSIGNED8	CONST	4
1018	01	Identity Object (Vendor ID)	UNSIGNED32	RO	0000047D
1018	02	Identity Object (Product Code)	UNSIGNED32	RO	AA060250
1018	03	Identity Object (Revision Number)	UNSIGNED32	RO	00030500
1018	04	Identity Object (Serial Number)	UNSIGNED32	RO	
1029	00	Error Behavior (Number of Entries)	UNSIGNED8	CONST	2
1029	01	Error Behavior (Communication Error)	UNSIGNED8	R/W	0
1029	02	Error Behavior (Sensor Error)	UNSIGNED8	R/W	0
1200	00	SDO Server Parameter (Number of Entries)	UNSIGNED8	CONST	2
1200	01	SDO Server Parameter (COB ID Client Server)	UNSIGNED32	RO	$NODEID+0x600
1200	02	SDO Server Parameter (COB ID Server Client)	UNSIGNED32	CONST	$NODEID+0x580
1800	00	TPDO1 Communication (Number of Entries)	UNSIGNED8	CONST	5
1800	01	TPDO1 Communication (COB-ID)	UNSIGNED32	R/W	$NODEID + 0x40000180
1800	02	TPDO1 Communication (Transmission Type)	UNSIGNED8	R/W	1
1800	03	TPDO1 Communication (Inhibit Time)	UNSIGNED16	R/W	0
1800	05	TPDO1 Communication (Event Timer)	UNSIGNED16	R/W	0
1A00	00	TPDO1 Mapping (Number of Entries)	UNSIGNED8	RO	2
1A00	01	TPDO1 Mapping (PDO Mapping Entry)	UNSIGNED32	RO	60100010
1A00	02	TPDO1 Mapping (PDO Mapping Entry)	UNSIGNED32	RO	60200010

* NOTE: Software revision output correction (object 0x100A). First releases may output “SW B26”, not “SW B27”.

Send PDO 1 (TPDO 1)

The default transmission rate for TPDO1 is at the receipt of every SYNC object. The transmission type can be changed based on the following table:

Transmission Type	Value
Acyclic, Synchronous	0
Cyclic, Synchronous	1-240
Manufacturer Specific	254

The Manufacturer Specific type transmits at the rate of the Inhibit Time (subindex 3).

The mapping for TPDO 1 is fixed and contains the 16-bit X and Y axis inclination angles (Objects 6010h and 6020h) mapped as follows:

Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
X-axis angle		Y-axis angle					

Manufacturer Specific Objects

INDEX (Hex)	SUB-INDEX (Hex)	OBJECT	Data Type	Access	Default Value (Hex)
4010	00	RS485 Switch	UNSIGNED8	R/W	0
4011	00	Mounting Orientation	UNSIGNED8	R/W	0
5555	00	Start in Operational Mode	UNSIGNED8	R/W	0

RS485 Switch (4010h)

Writing any value to this object will set the H6MM-CANOPEN to RS485 on next power up. This feature disables the CAN hardware interface!

WARNING: After power reset, the device will no longer communicate on the CAN bus!

Mounting Orientation (4011h)

Writing a zero to this object (default) sets the H6MM-CANOPEN to horizontal mount orientation (see Horizontal Mount Axis Orientations).

Writing a one to this object sets the H6MM-CANOPEN to vertical mount orientation (see Vertical Mount Axis Orientations).

Start in Operation Mode (5555h)

Writing a one to this object will set the H6MM-CANOPEN to automatically start in Operation Mode without the presence and Network Management of a CANopen Master. Any other value disables this feature.

WARNING: Used only for debugging. Do not use in normal operations!

Inclinometer Device Specific Objects (per DSP-410)

INDEX (Hex)	SUB-INDEX (Hex)	OBJECT	Data Type	Access	Default Value (Hex)
6000	00	Resolution	UNSIGNED16	R/W/W	A
6010	00	16-bit X Axis (Longitudinal) Inclination	INTEGER16	RO	
6011	00	16-bit X Axis (Longitudinal) Operating Parameters	UNSIGNED8	RO	0
6020	00	16-bit Y Axis (Lateral) Inclination	INTEGER16	RO	
6021	00	16-bit Y Axis (Lateral) Operating Parameters	UNSIGNED8	RO	0

X-axis Operating Parameters (6011h)

With the current revision of H6MM-CANOPEN software, the operating parameters cannot be modified and are fixed at no inversion and no scaling. Future revisions of the inclinometer will enable this and other Device Specific Objects.

Y-axis Operating Parameters (6021h)

With the current revision of H6MM-CANOPEN software, the operating parameters cannot be modified and are fixed at no inversion and no scaling. Future revisions of the inclinometer will enable this and other Device Specific Objects.

LSS: Change Baud Rate and Node-ID

The Node-ID and Baud Rate of each H6MM-CANOPEN can be changed through LSS (Layer Setting Service) per CiA DS-305. LSS allows a CANopen master to read and change the settings of certain parameters of the H6MM-CANOPEN. The following parameters can be read and/or changed:

- Node-ID
- CAN bus baud rate

By using LSS, the H6MM-CANOPEN can be configured for any CANopen network without physical configuration methods like DIP switches.

EDS file

The electronic data sheet (EDS file) for the H6MM-CANOPEN inclinometer is available here: https://www.riekerinc.com/find-product/h6/h6mm-documents/.

References

[DS-301] CiA DS-301 V4.2 – CANopen Application Layer and Communication Profile.

[DS-305] CiA DS-305 V2.0 – Layer Setting Service (LSS) and Protocols.

[DS-410] CiA DS-410 V1.2 – CANopen profile for inclinometer.

These documents are available from the CAN in Automation website http://www.can-cia.org/.