OSX – Open-SDI12-Blue

Version Distance and Snow Depth, Type 430

1 Quick setup

Basic Version (MB-001). Size ca. 12cm x 5/3cm. Sensor is IP67

The **OSX Distance and Snow Depth** is a low-cost SDI12 Transmitter for distance, using ultrasonic signals.

The sensor is available in different version:

- MB-001: Basic Sensor, Low-Power (3.6V - 16V Supply)
- MB-002: Snow Depth (larger transmitter), Low-Power (3.6V - 16V Supply)
- MB-003: Snow Depth (larger transmitter), High-Precision (with ice protection/self cleaning) (this version requires constant power of ca. 30 mA - 50 mA and 7.5V – 16V Supply)
- MB-xxx: Other applications (please contact us for the ideal sensor)

Common data OSX:

- Default range 0.5 to 5 mtr, Resolution 1 mm, Precision typically +/-2 mm
- Temperature range -10 °C – +65 °C
- Sensor elements are from https://www.maxbotix.com (also valuable source for data sheets!)

SDI-12-Cable (core cable ends or optionally with Connector (AKL-169-04 (RIA CONNECT, RM 3.5mm)):

BLACK:	GND
BROWN:	3.6V(7.5V) - 16V Supply
BLUE:	SDI-12 Signal

The command set is based on standard SDI12 (V1.3) command set. Most important commands:

aAn! : Change Address from ‘a’ to ‘n’. (a might be always be a ‘?’ as wild card).

aI! : Identify Node (should identify as ‘a13TT_MBX_A_0430_OSXxxxxxxxx’)

aM! : Start measure (also ‘aMC!’). This will start the measure. After finishing all measured values are available in an internal cache. 1 Data may be read with the „D“- command: a.) Distance in mm

aM1! : Start measure (also ‘aMC1!’). This will start the measure including Supply Voltage. After finishing all measured values are available in an internal cache. Up to 2 data may be read with the „D“- command:
a.) Distance in mm, b.) Voltage

aD0! : This will read the 1 to max. 2 measures from the preceding „M“- command.

Error codes (all values lower than -900):

-999: Sensor internal error (‘No Reply1’) probably sensor or internal connection broken.
-998: Sensor internal error (‘No Reply2’) probably sensor or internal connection broken.
others: Displayed as text in BLX.JS or BlueShell

2 Basic Application (MB-001)

Measuring the distance is based on ultrasonic signals and requires only very little power. The sensors are factory calibrated to eliminate the effects of temperatures. The measure time is short (normally 1 – max. 5 sec) and power low (< 20 mA average).

Technical Info: by default For MB-001 the Sensor element “MB7384” from https://www.maxbotix.com is used.

3 Application for Snow Depth (MB-002/-003)

Since the surface of snow is “soft”, measuring the level is more difficult than for harder surfaces. Also use in wet and cold environments bares the risk of icing or condensation.

Hence the Snow Depth version is available in 2 different versions:

- MB-002 is powered only “if used” (same as MB-001) and ideal for battery operated use!

  Technical Info: by default For MB-002 the Sensor element “MB7374” from https://www.maxbotix.com is used in combination with an extended Horn.

- MB-003 is constantly powered and needs ca. 30 mA - 50 mA. The advantages are better measurement results, even with "soft" surfaces, better filtering of the data and safe

prevention of condensation or icing. A small solar panel will be sufficient to supply the energy!

The manufacturer of the Sensor element calls this feature “self cleaning”: “*The SCXL-MaxSonar-WR sensors feature a self-cleaning protocol which gently heats the face of the transducer, and atomizes any moisture/condensation on the sensor’s transducer face. This feature allows the sensor to be used in a wide variety of applications that may experience condensation issues. Self-cleaning is needed for many such applications due to detection performance limitations resulting from condensation, including only reporting the minimum or maximum reported distance. Condensation is frequently an issue in tanks because the sensor is typically mounted at the top of the tank, above snow or a warmer liquid. On clear nights or cold nights, this causes the sensor hardware to be colder than its surrounding environment, causing condensation to build up on the surface of the exposed sensor hardware. This can also occur in some buildings, depending on climate control. The reason that condensation is problematic to sensors is fairly straightforward. Sensors determine distance to targets, even if that target is on the surface of the transducer. Targets (condensation, solid particles, etc.) on the surface of the transducer impede sensor operation. These targets (on the surface of the transducer) will either be detected or cause a reduction in the sensitivity of the sensor. The self-cleaning operation is designed to prevent and remove of buildup moisture from the surface of the transducer. The self-cleaning feature is only designed for moisture, not removal of dust or other solid particles. For proper self-cleaning, the sensor must remain on, and continue normal ranging operation.*”

Technical Info: by default For MB-003 the Sensor element “MB7574” from https://www.maxbotix.com is used in combination with an extended Horn.

For more details please ask us for data sheets and application notes!

4 The Open-SDI12-Blue platform

OSX Sensors are based on an open platform:

Link: https://github.com/joembedded/Open-SDI12-Blue

5 Software

5.1.1 Software to access the sensor

OSX Sensors can accessed by SDI12 (V1.3) or Bluetooth BLE or SDI12 via Bluetooth.

- BlueShell for PC (Windows 10 / 11)
- BLX.JS (PC (Browsers: Chrome, Edge, Opera, …) or Android). No APP required!

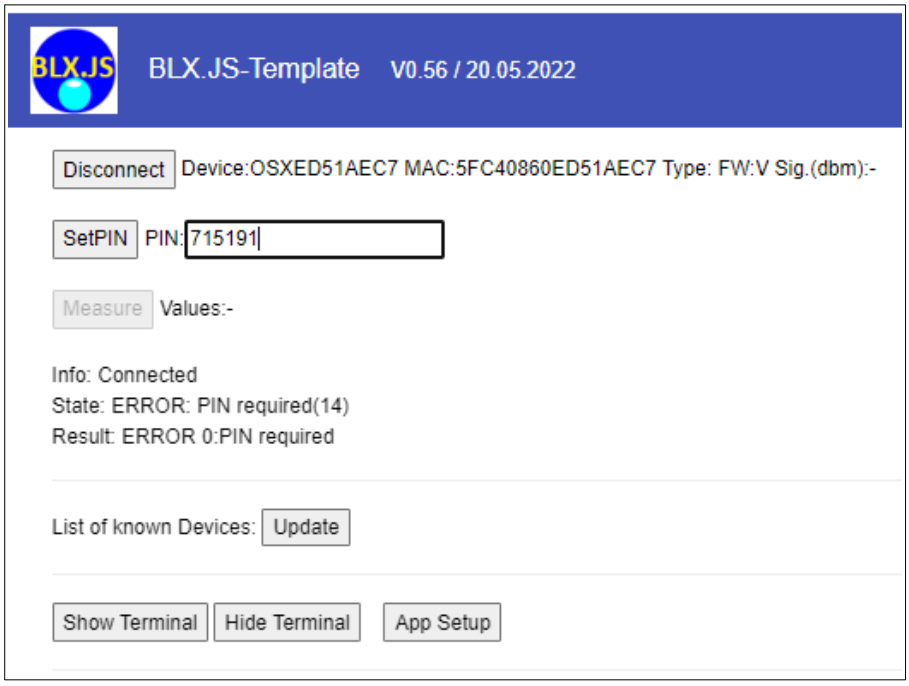
Link: Download Link BlueShell or BLX.JS

5.1.2 Software for SDI12

- A simple SDI12Term for PC (Windows) (connect SDI12 sensors via RS232)

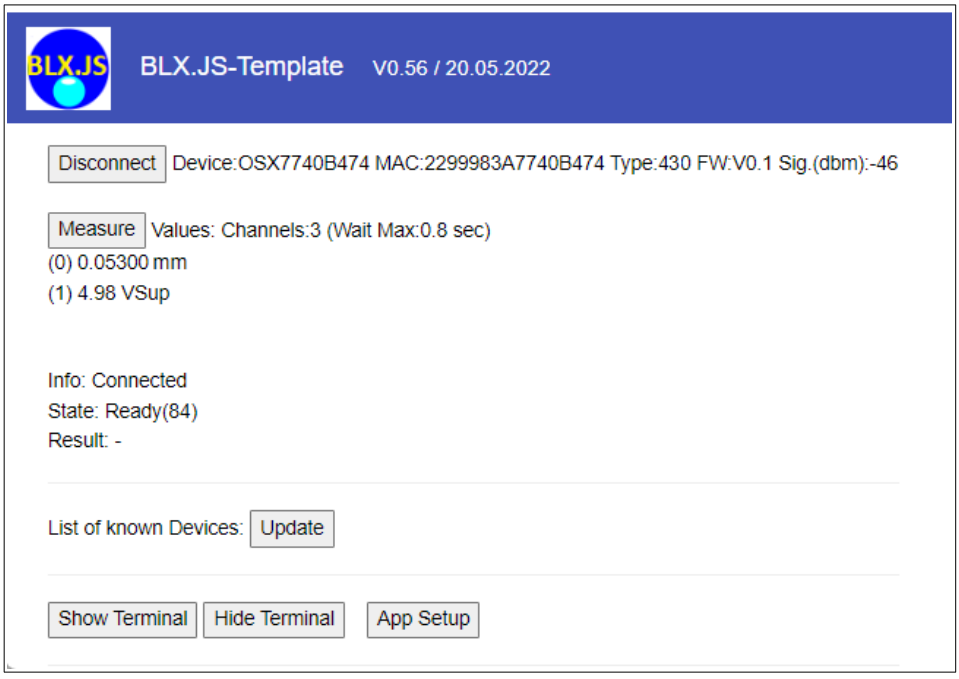
Link: https://github.com/joembedded/SDI12Term

6 Sample session BLX.JS



Enter PIN only required once!

The sensors are locked with a 6 digit PIN (Authentification method: Challenge-Response)



Measure

7 Commands

A selection of commands for setup (enter via BLX.JS or BlueShell Terminal)

7.1.1 Commands for this type (Type 430):

Measure:

- M or MC or M1 or MC1 starts the measure, measure takes ca. 1 - 5 sec (optionally the Warm-Up Time can be changed, see below)
- D replies the values

7.1.2 Standard commands for Open-SDI12-Blue (SDI12 via BLE):

All „SDI12 via BLE“ commands are preceded by ‚z‘:

> z?I!	SDI12 via BLE: Identify
Reply: '013TT_KLD_A_0310_OSX7740B474<CR><LF>'	
End: 'OK' (Runtime: 229 msec)	
> z?M!	SDI12: Measure
Reply: '00012<CR><LF>'	
Reply: '0<CR><LF>'	
End: 'OK' (Runtime: 358 msec)	
> z?D0!	SDI12: Values
Reply: '0+0.00032<CR><LF>'	
End: 'OK' (Runtime: 302 msec)	
> z?MC!	SDI12: Measure+CRC
Reply: '00012<CR><LF>'	
Reply: '0<CR><LF>'	
End: 'OK' (Runtime: 387 msec)	
> z?D0!	SDI12: ‚@|‘ is CRC
Reply: "0+0.00025@C|<CR><LF>'	
End: 'OK' (Runtime: 290 msec)	
> z?XDevice!	SDI12: XDevice
Reply: '0M:2299983A7740B474,T:430,V1.0, P:321144!<CR><LF>'	SDI12: Red: Device.PIN
End: 'OK' (Runtime: 299 msec)	
> z?XSensor!	SDI12: Get Sensor Settings
Reply: '0LMB-001!<CR><LF>!	SDI12: Type ‘MB-001’
End: 'OK' (Runtime: 100 msec)	
> z?XFactoryReset!	SDI12: Factors Reset:
Disconnected while Busy('z?XFactoryReset!')	SDI12: New setup
ERROR: Disconnected ('z?XFactoryReset!')	SDI12: required!

7.1.3 Some standard commands for BLX.JS (not available with BlueShell):

(Remark: BLX.JS is our BLE driver written in JavaScript, it could easily be used with other HTML too).

> .a	.a or .audio: „Finder“
Audio: RSSI: OFF, Term: ON	
> .audio 1 1	Audio & Finder ‚ON‘
Audio: RSSI: ON, Term: ON	
> .firmware	Secure firmware update
Select new firmware (*.sec)...	

7.1.4 Special commands for Open-SDI12-Blue (SDI12 via BLE):

Sensor setup / scan commands:

Important: our sensors are are delivered “ready-2-run” and normally no special setup is required (except e.g. after Factory Reset or if sensor configuration was changed). The following commands are only listed for technical completeness or for changed setup (e.g. output in cm, mtr. or others)

- Each channel has 2 coefficients for (optional) user calibration.
  By default these coefficients are 1.0 (Multi) and 0.0 (Offset), this means the values of the sensor are not changed. The sensor elements are internally factory calibrated to mm (units may be changed).
- The sensor measures Distance from itself in mm. To change the level e.g. to cm, the multiplication factor can be changed from 1.0 to 0.1. Also it is possible to set the sensor to Level, is a negative factor is used, see below:
- The 2 Coefficients:
  Formula is (BLX standard): Formula: VALUE = (MEASURED * Multi) – Offset.
  K0: Pressure Multi (Default: 1.0)
  K1: Pressure Offset (Default: 0.0)
- The coefficient ‘P’ is the Sensor's Warm-Up Time. Default is 2500 msec. However it can be set to 1..9999 msec with the “P”-Command. If the P is set to 0, the Sensor is constantly powered (Higher Power consumption! Please note: This is standard for type MB-003).
- The “Write” command writes changed parameters to Flash.

In this example the sensor is set to Level and cm, the sensor is mounted 200 cm above ground:

> e	Measure
Measure (1 Channels in 1750 msec) (0)522.7 mm	
> z?XK0!	Check K0 (Multi)
Reply: '0K0=1.000000<CR><LF>' End: 'OK' (Runtime: 389 msec)	
> z?XK0=-0.1!	Set K0 to mm (negative)
Reply: '0K0=-0.1<CR><LF>' End: 'OK' (Runtime: 246 msec)	
> z?XK1!	Check K1 (Offset)
Reply: '0K1=0.000000<CR><LF>' End: 'OK' (Runtime: 387 msec)	
> z?XK1=-200!	Set K1 to Zero-Level
Reply: '0K1=-200<CR><LF>' End: 'OK' (Runtime: 246 msec)	
> z?XU0!	Check Unit 0
Reply: '0U0='cm'<CR><LF>' End: 'OK' (Runtime: 206 msec)	
> e	Check results
Measure (1 Channels in 1750 msec) (0)1.478 cm	
> z?XWrite!	Save Settings to Flash
Reply: '0<CR><LF>' End: 'OK' (Runtime: 162 msec)	

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8 Power Supply

The OSX Sensor works from 2.8V to 16V (see Open-SDI12-Blue documentation).

However the ultrasonic sensor elements require at least 3.6V (MB-001/-002) or 7.5V (MB-003)

Measure: ca. 20mA for ca. 1 sec - 5 sec (Default, if Warm-Up Time is set to 0, the sensor element is constantly powered). Only MB-003: Continous self cleaning and ice protection: ca. 30 mA - 50 mA and 7.5V – 16V Supply)

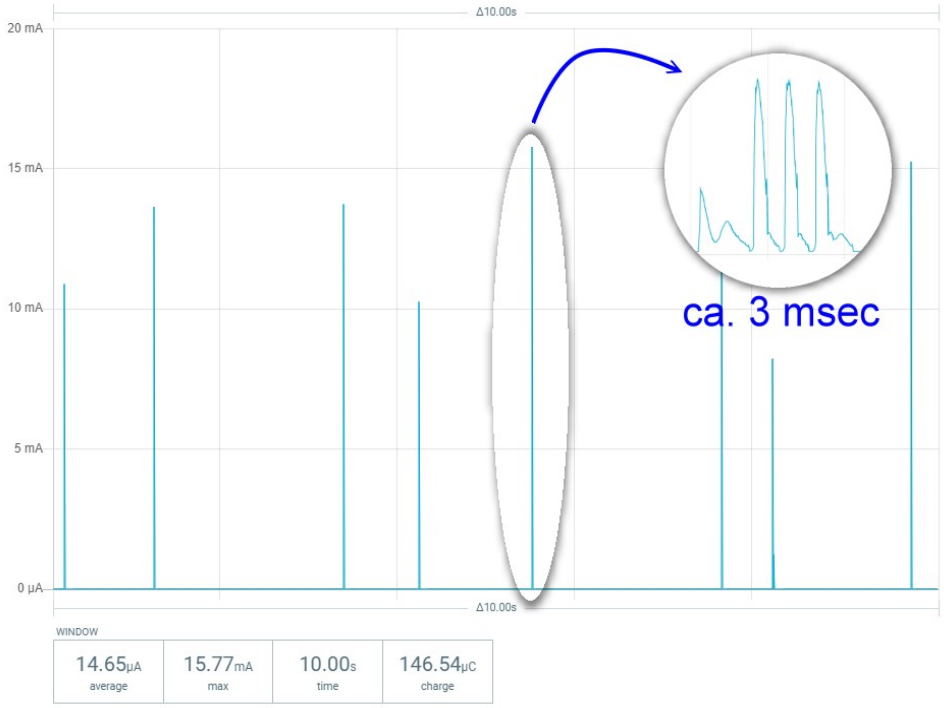
Operating Temperature: -40°C - +65°C
Power Profile

8.1.1 Power Up Sequence

The OSX Sensor is ready after ca. 250 msec (warm up for ultrasonic sensors not included)

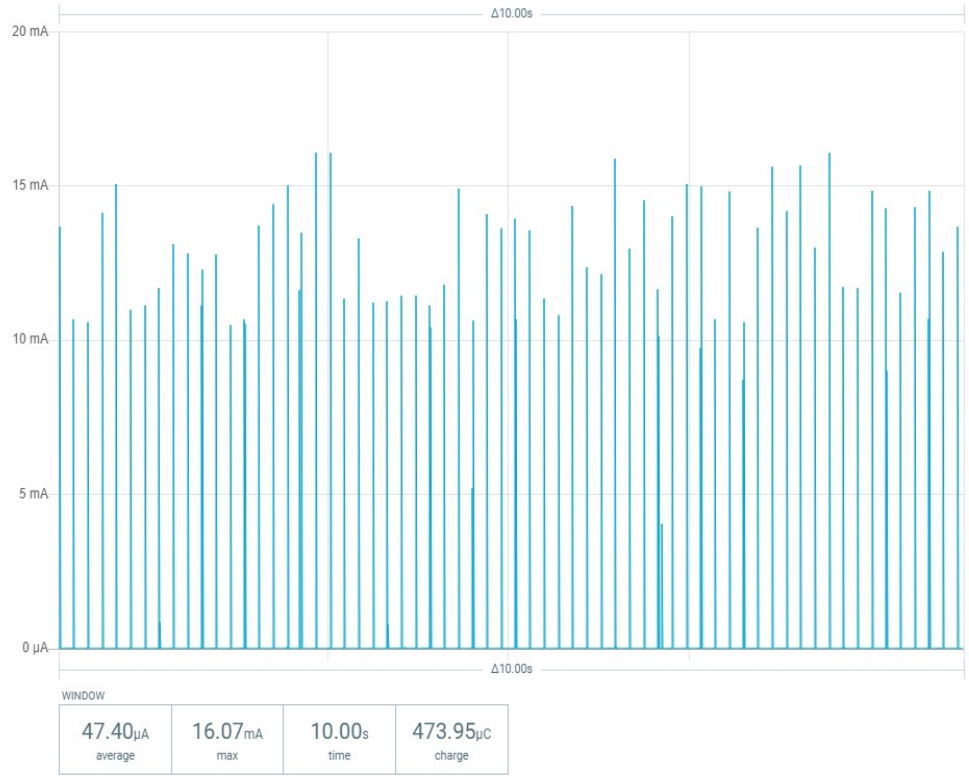
8.1.2 Advertising (in deep sleep)

Average power consumption in deep sleep is <15 µA @ 5V (only MB.001/-002)



Advertising power consumption (one peak zoomed)

8.2 Connected Mode



Connected power consumption

In Connected Mode (active BLE connection) the average power consumption is <50 µA @ 4V (only MB-001/-002)

9 Compliance (Distance and Snow Depth, Type 430)

9.1 Compliance: CE, RoHS

- EN 55022 Emission, class B < 30 dBµV/m (0.03...1 GHz)
- EN 61000-4-2 Electrostatic discharge 4 kV contact / 8 kV air
- EN 61000-4-3 Irradiated RF 10V/m (0.1...1 GHz)
- EN 61000-4-4 Transients (burst) 4 kV
- EN 301 489-1 V2.1.1 and EN 301 489-17 V3.1.1 EMC
- EN 300 328 V2.1.1 EN 300 330 V2.1.1 Radio Emission
- Bluetooth SIG listed: ID 138612

The sensor OSX – Version Distance and Snow Depth complies with the essential requirements of Radio Equipment Directive (RED) 2014/53/EU and with the Directive 2011/65/EU (EU RoHS 2) and its amendment Directive (EU) 2015/863 (EU RoHS 3).

Manufacturers:

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