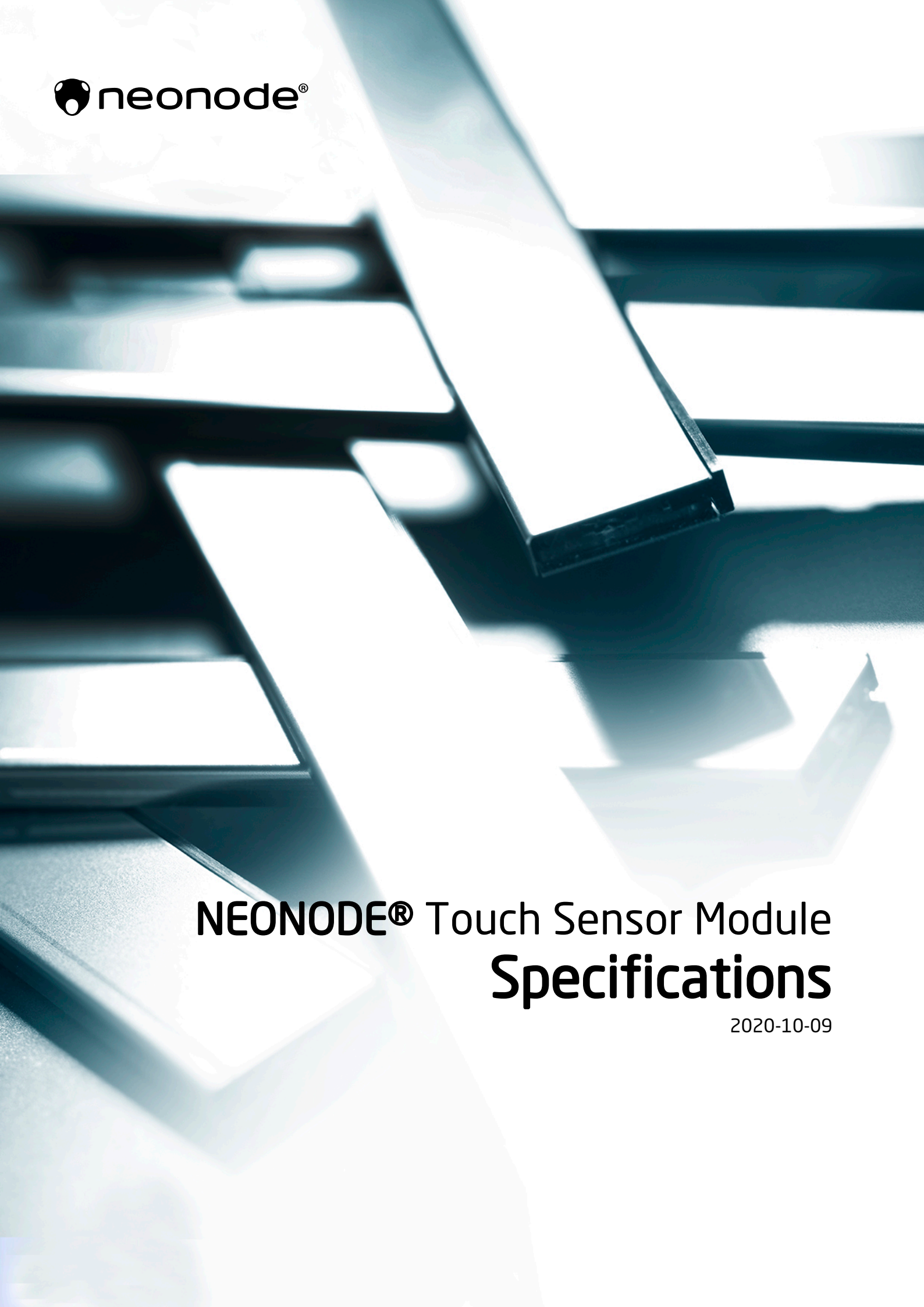


NEONODE® Touch Sensor Module
Specifications

2020-10-09

Legal Notice

Neonode may make changes to specifications and product descriptions at any time, without notice. Do not finalize a design with this information. Neonode assumes no liability for applications assistance or customer product design. Customers are responsible for their products and applications using Neonode components. To minimize the risks associated with customer products and applications, customers should provide adequate design and operating safeguards.

Neonode components are neither designed nor intended for use in FDA Class III applications, or similar life-critical medical equipment. Customers acknowledge and agree that they will not use any Neonode components in FDA Class III applications, or similar life-critical medical equipment, and that Neonode will not be responsible for any failure to meet the requirements of such applications or equipment.

1 Table of Contents

2 Specifications

2.1 Specifications Summary

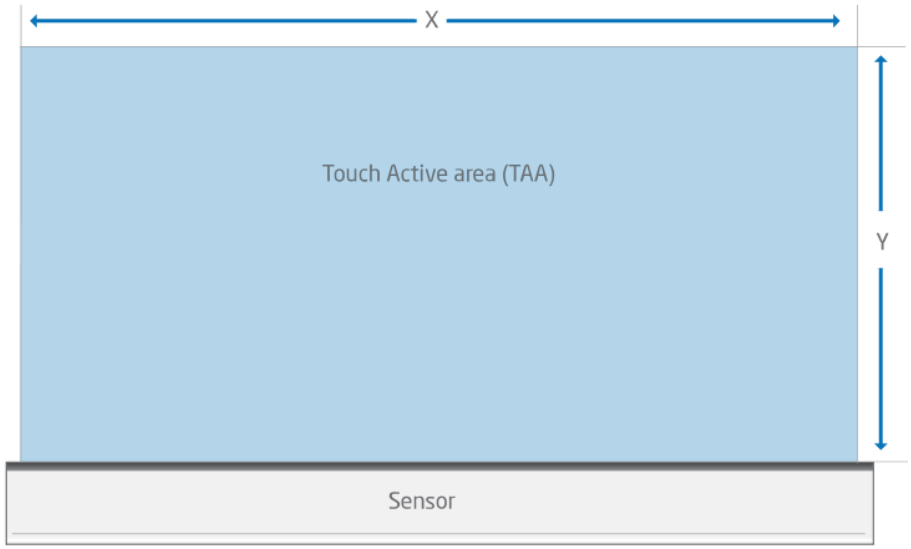
2.1.1 Touch Performance Specification

Item	Specification
Input methods	Finger, hand or glove.
Minimum object size (diameter)	5 mm
Number of touch objects	1, 2, or more, depending on application
Touch resolution	0.1 mm
Touch activation force	0 N (no activation force required)
Touch Active Area	Up to 345.6 x 327.7 mm. For details, refer to information on product variants in Introduction[1].
Response time	~50 ms (initial touch, at 33 Hz in idle mode) 10 ms (continuous tracking, at 100 Hz in active mode)
Scanning frequency	Configurable up to 900 Hz, depending on product variant. For details, refer to Touch Performance (see page 8).

Touch accuracy

The specified values are valid for the used test setup. For more information, refer to Performance Test Methods[2]. The touch accuracy is measured inside the TAA, using a silicone based cylindrical test rod with a diameter of 16 mm.

1 https://support.neonode.com/docs/display/AIRTSUsersGuide/Introduction
2 https://support.neonode.com/docs/display/AIRTSUsersGuide/Performance+Test+Methods



Touch Accuracy for Normal Range Sensor Modules of the 90° and 0° Types

Product Number	Typical Value (mm)	μ ± 2σ (mm)
NNAMC346XPC01	1.5	3.5
NNAMC310XPC01	1.5	3.5
NNAMC295XPC01	1.5	3.5
NNAMC230XPC01	1.5	3.5
NNAMC209XPC01	1.5	3.5
NNAMC180XPC01	1.5	3.5
NNAMC158XPC01	1.5	3.5
NNAMC122XPC01	1.5	3.5
NNAMC115XPC01	1.5	4

Typical Value: The accuracy on average, within the TAA.
μ ± 2σ: 95% of reported touch positions deviate less than this value. (2σ standard deviation).
Product number: "X" indicates if the sensor module is of type 0° ("0") or 90° ("1").

The accuracy specification (normal range, 0° and 90°) is valid for units produced from 15th January 2020. Please contact our support team for specification regarding earlier produced sensor modules, or general questions about the accuracy specification.

Touch Accuracy for Extended Range Sensor Modules of the 90**° and 0° Types**

Product Number	Typical Value (mm)	μ ± 2σ (mm)
NNAMC346XPC01	2.5 [1]	5 [1]

Typical Value: The accuracy on average, within the TAA.
μ ± 2σ: 95% of reported touch positions deviate less than this value. (2σ standard deviation).
Product number: "X" indicates if the sensor module is of type 0° ("0") or 90° ("1").
[1] Preliminary value.

The accuracy specification (extended range, 0° and 90°) is valid for units produced from 15th January 2020. Please contact our support team for specification regarding earlier produced sensor modules, or general questions about the accuracy specification.

Technical Specification

Item	Sensor module Variant	Specification
Module size (LxHxW)	0° Type	L x 3.46 x 14.5 mm L depending on product variant.
	90° Type	L x 3.46 x 16.05 mm L depending on product variant.
Power consumption I2C interface Active mode (100 Hz)	NNAMC0720PC01, NNAMC0721PC01	57 mW
	NNAMC2090PC01, NNAMC2091PC01	80 mW
	NNAMC3460PC01, NNAMC3461PC01	104 mW
	NNAMC3460PC01, NNAMC3461PC01, Extended Range	135 mW
Power consumption I2C interface Idle mode (33 Hz)	NNAMC0720PC01, NNAMC0721PC01	44 mW
	NNAMC2090PC01, NNAMC2091PC01	45 mW
	NNAMC3460PC01, NNAMC3461PC01	47 mW

Item	Sensor module Variant	Specification
	NNAMC3460PC01, NNAMC3461PC01, Extended Range	61 mW

2.2 Touch Performance

2.2.1 Touch Object Requirement

The Neonode Touch Sensor Module detect and trace objects by detecting diffusely reflected infrared light.

Requirements on the object to detect include:

- A minimum reflectance of 30% in the near IR-spectrum is needed for proper signal levels, that is, the object can not be too dark.
- Object surface must be diffuse. A glossy or mirror-like object may not scatter enough light towards correct receivers in order to generate a reliable detection.
- An object must be ≥ 5 mm to ensure sufficient signal levels. This is closely related to reflectance. A white, diffuse object may be smaller than a dark, glossy one.

2.2.2 Touch Accuracy

Specification

Measured touch coordinate error in X and Y axis is less or equal than the specified value for about 95% of the cases.

Touch coordinate error data is calculated by subtracting the actual position and measured position in X and Y axis.

Definition

The touch accuracy of the Touch Sensor Module can be described statistically with the normal distribution and a standard deviation of 2 sigma. This means that the touch position reported by the sensor module will deviate less than the specified value in 95% of the cases.

2.2.3 Response Time

The specification of response time reflects the reaction speed of a Touch Sensor Module.

Specification

- **Initial touch**: ~50 ms, at 33 Hz scanning frequency (default frequency in idle mode).
- **Continuous tracking**: 10 ms, at 100 Hz scanning frequency (default frequency in active mode).

Increasing the scanning frequency decreases the response time.

Definition

Initial Touch

The specified response time for the **initial touch** starts from the instant an object is presented in the sensor module's touch active area and stops when the module starts to send the first touch notification for this object. The specified response time consists of two numbers reflecting the best case and the worst case, with the average response time right in the middle.

The response time (t) can be calculated for different idle mode frequencies (f) can be calculated by the formulas below:

Best case: *t = 16 ms*

Worst case: *t = 1/f + 16 ms*

Average: *t = (1/f + 32 ms) / 2*

In touch applications, an object will be detected slightly before it reaches the touch surface, making the perceived response time shorter.

Continuous Tracking

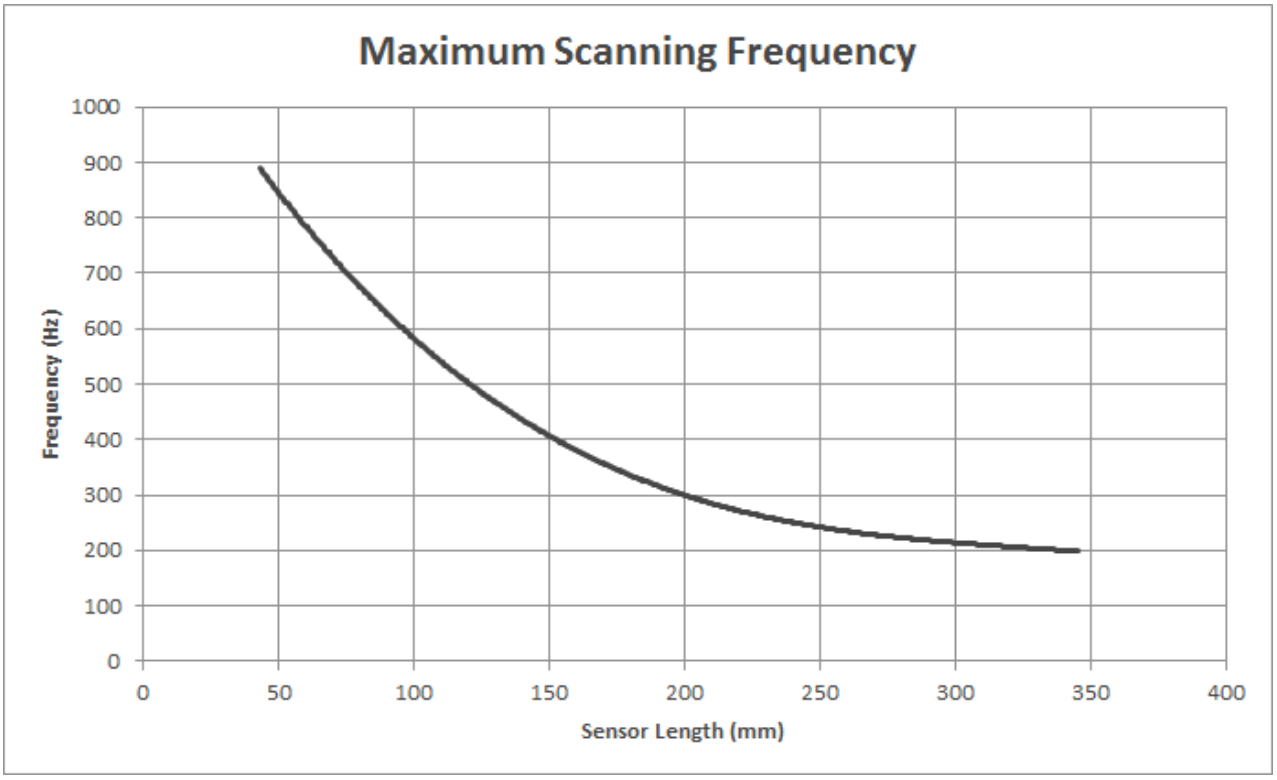
After the first touch notification, the sensor module will **continuously track** and send touch notifications to update the object position. The response time is therefore defined as the time between subsequent touch notifications.

The response time (t) can be calculated for different active mode frequencies (f) can be calculated by the formula below:

t = 1/f

2.2.4 Scanning Frequency

The scanning frequency can be set using the Neonode API. The default value is 100 Hz in active mode, that is, when an object is detected or tracked. The default value in idle mode, that is, when no object is detected or tracked, is 33 Hz. The maximum scanning frequency depends on the product variant (sensor module's length). See the following chart.

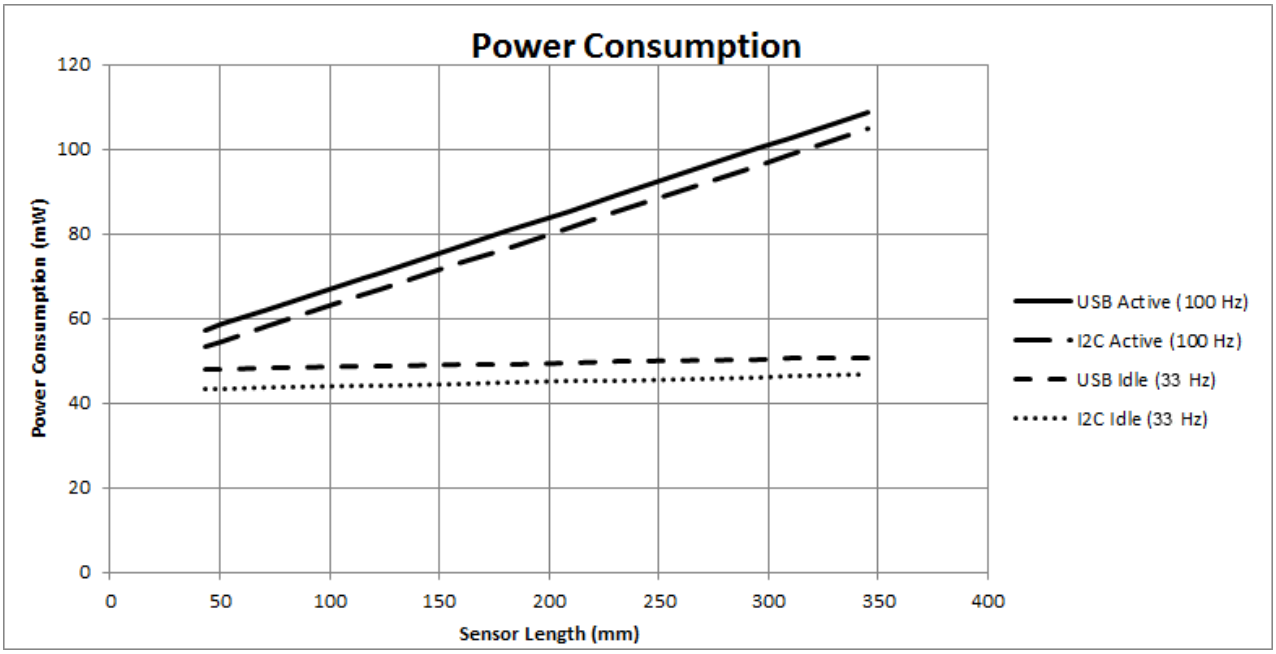


The maximum scanning frequency for product variants NNAMC3460PC01 and NNAMC3461PC01 with Extended Range is 175 Hz.

2.3 Power Consumption

2.3.1 Specification

The graph below shows the power consumption for various sensor module's lengths, in active and idle mode. In active mode, the scanning frequency is set to 100 Hz, and one object is presented in active area. In idle mode the scanning frequency is set to 33 Hz, with a clean active area. With higher scanning frequency or more detected objects, the power consumption might slightly higher than the values in the graph. The sensor module will only be in active mode when a touch object is being detected or tracked.



.

From firmware version 1.49 and higher, the sensor module types NNAMC3460PC01 and NNAMC3461PC01 are provided with Extended Range, and their power consumption increases 30% in both USB active mode and USB idle mode. The power consumption for module types shorter than 237 mm is not affected by Extended Range.

2.3.2 Definition

The power consumption is calculated from the current consumption when supplying the sensor module with 5 V.

The current consumption is, in turn, defined as the average current that goes through a sensor module. This is measured from the +5V power pin and reflects how much electric energy that is consumed by the whole sensor module. In real time, the current is not a stable value. Since the Touch Sensor Module has a low power consumption design, the processor and some peripheral circuits will switch to sleep mode during the time between two scan periods, to save power. Therefore, the current is frequently changing during run time.

According to the different working modes of the Touch Sensor Module, the current consumption value also changes between Active mode and Idle mode.

2.4 Environmental Requirements

2.4.1 Operating and Storage Conditions

Condition	Operation	Storage
Temperature	–20°C to +65°C	–40°C to +85°C
Humidity	5% to 95%	0% to 95%

Condition	Operation	Storage
Altitude	≤5000 m	≤15 km

2.4.2 ESD rating

EN55024
(61000-4-2)
Direct contact discharge: 4 kV
Indirect contact discharge: 4 kV
Air discharge: 8 kV

2.4.3 Agency Approvals

RoHS, IEC60825-1 Class 1

2.5 Electrical Requirements

2.5.1 Absolute Maximum Ratings

Parameter	Max Rating	Unit
Supply voltage	-0.3 to 6.0	V
Input voltage on I/O pins	-0.3 to 5.5	V

2.5.2 Recommended Operating Conditions

Parameter	Min	Typ	Max	Unit
Supply voltage	4.50	5.00	5.50	V

2.6 Optical Requirements on External Window

Most applications will require an outer cover window, for design cosmetics and protection against dust and humidity.

The optical properties on cover windows placed in front of the Touch Sensor Module are essential in order to maintain a high touch performance. If light is lost, scattered or diverted it will lead to shorter detection range and lower touch accuracy.

2.6.1 Optical Requirements

Window material must be optically clear, without absorption and have optical quality surfaces.

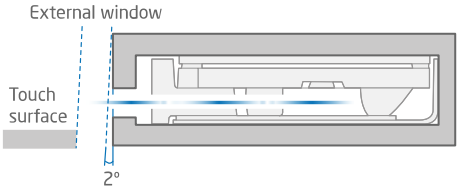
- Transmission: > **88 % at 945nm**
- Haze: **< 3%**
- Surface finish: **SP1-A2 (max Ra 0.05µm).**

Proven plastic materials include optical grade acrylic (PMMA) and polycarbonate. For glass windows, transmission at 945 nm must be verified. Many borosilicate glasses (such as Borofloat) work well, but some common window glasses show substantial absorption due to high iron content.

2.6.2 Geometrical Constraints

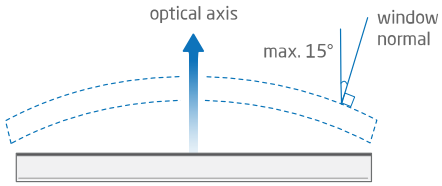
The Touch Sensor Module is an optical system that both emits and receives IR-light at different incident angles. When the light hits a transparent material, most of the light is transmitted through the material and exit on the other side. But in reality the amount of light being transmitted is angle dependent, why some shape constraints exist on windows placed in front of the sensor module:

- **Window surfaces must be parallel.**
  A wedge, or lens shaped window will shift light beams out of the active area.
- It is a good practice to install the window at a slight angle (~2°) to reduce reflected stray light. See the image below. The angle can be up to approximately 30° without affecting performance.

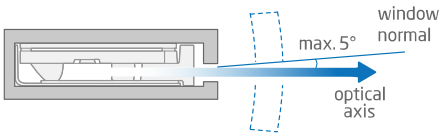


- A slight curvature on the window can be allowed.

- In x-direction, a maximum angle of 15° between window normal and sensor module's optical axis is recommended, for all parts of the window within the sensor module's TAA.



- In z-direction, the angle should be maximum 5°.



, which corresponds to a minimum radius of 12 mm for the surface closest to the sensor module.

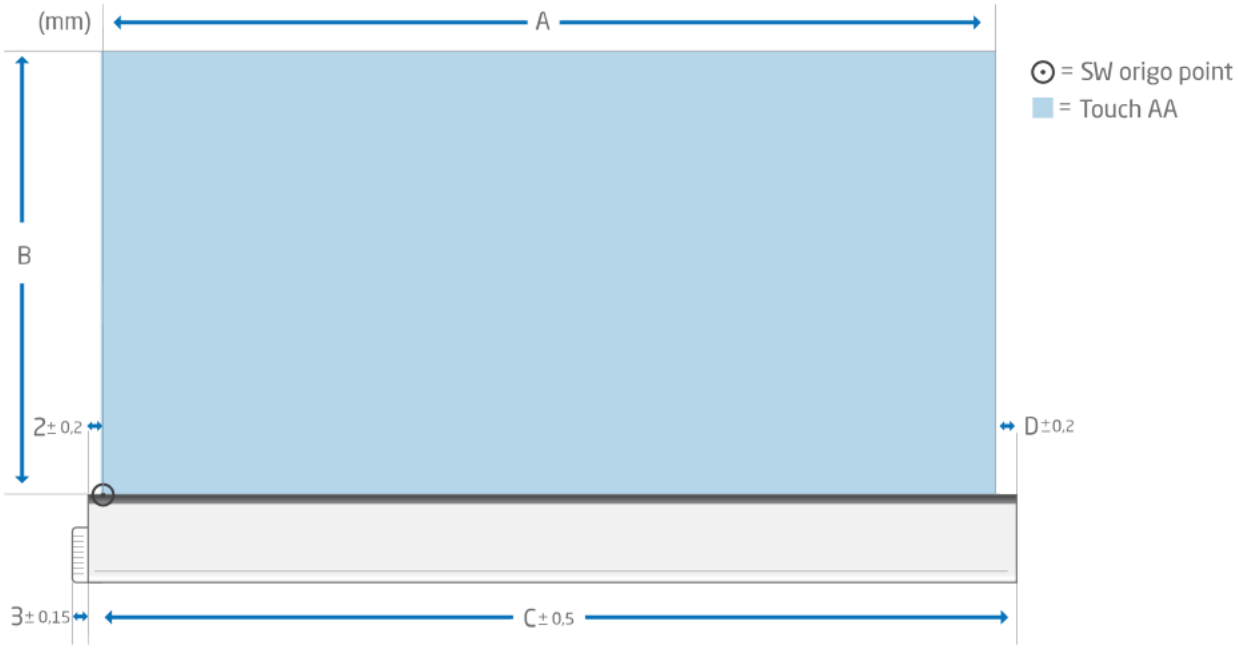
- Keep window thickness as small as mechanically feasible, to reduce absorption losses.

2.7 Mechanical Data

2.7.1 Physical Dimensions and Position of Origin

Top View

Dimensions **C** and **D** vary between the Touch Sensor Module types (0° and 90°) and therefore also the Touch Active Area (TAA) sizes (**A** and **B**). For Touch Sensor Module types with A ≥ 237.6 mm, dimension B also depends on the installed firmware version.



Product number		Measurements (mm)			
0°	**90°**	**A**	**B**	**C**	**D**
NNAMC0430PC01	NNAMC0431PC01	43.2	14.9	47.2	2
NNAMC0500PC01	NNAMC0501PC01	50.4	29.8	55.9	3.5
NNAMC0580PC01	NNAMC0581PC01	57.6	29.8	61.6	2
NNAMC0640PC01	NNAMC0641PC01	64.8	44.7	70.3	3.5
NNAMC0720PC01	NNAMC0721PC01	72	44.7	76	2

Product number		Measurements (mm)			
0°	90°	A	B	C	D
NNAMC0790PC01	NNAMC0791PC01	79.2	59.6	84.7	3.5
NNAMC0860PC01	NNAMC0861PC01	86.4	59.6	90.4	2
NNAMC0940PC01	NNAMC0941PC01	93.6	74.5	99.1	3.5
NNAMC1010PC01	NNAMC1011PC01	100.8	74.5	104.8	2
NNAMC1080PC01	NNAMC1081PC01	108	89.4	113.5	3.5
NNAMC1150PC01	NNAMC1151PC01	115.2	89.4	119.2	2
NNAMC1220PC01	NNAMC1221PC01	122.4	104.3	127.9	3.5
NNAMC1300PC01	NNAMC1301PC01	129.6	104.3	133.6	2
NNAMC1370PC01	NNAMC1371PC01	136.8	119.2	142.3	3.5
NNAMC1440PC01	NNAMC1441PC01	144	119.2	148	2
NNAMC1510PC01	NNAMC1511PC01	151.2	134.0	156.7	3.5
NNAMC1580PC01	NNAMC1581PC01	158.4	134.0	162.4	2
NNAMC1660PC01	NNAMC1661PC01	165.6	148.9	171.1	3.5
NNAMC1730PC01	NNAMC1731PC01	172.8	148.9	176.8	2
NNAMC1800PC01	NNAMC1801PC01	180	163.8	185.5	3.5
NNAMC1870PC01	NNAMC1871PC01	187.2	163.8	191.2	2
NNAMC1940PC01	NNAMC1941PC01	194.4	178.7	199.9	3.5
NNAMC2020PC01	NNAMC2021PC01	201.6	178.7	205.6	2
NNAMC2090PC01	NNAMC2091PC01	208.8	193.6	214.3	3.5
NNAMC2160PC01	NNAMC2161PC01	216	193.6	220	2
NNAMC2230PC01	NNAMC2231PC01	223.2	208.5	228.7	3.5
NNAMC2300PC01	NNAMC2301PC01	230.4	208.5	234.4	2

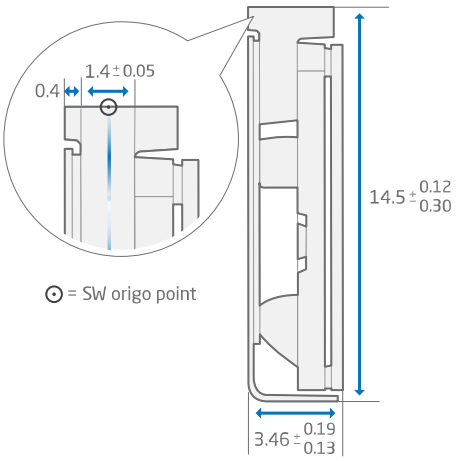
Product number		Measurements, Non-Extended Range (mm)					Measurements, Extended Range (mm)				
0°	90°	A	B	C	D	From Firmware Version	A	B	C	D	From Firmware Version
NNAMC2380PC01	NNAMC2381PC01	237.6	208.5	243.1	3.5	v1.38	237.6	223.4	243.1	3.5	Available on request
NNAMC2450PC01	NNAMC2451PC01	244.8	208.5	248.8	2	v1.38	244.8	223.4	248.8	2	Available on request
NNAMC2520PC01	NNAMC2521PC01	252	208.5	257.5	3.5	v1.38	252	238.3	257.5	3.5	Available on request
NNAMC2590PC01	NNAMC2591PC01	259.2	208.5	263.2	2	v1.38	259.2	238.3	263.2	2	Available on request
NNAMC2660PC01	NNAMC2661PC01	266.4	208.5	271.9	3.5	v1.38	266.4	253.2	271.9	3.5	Available on request
NNAMC2740PC01	NNAMC2741PC01	273.6	208.5	277.6	2	v1.38	273.6	253.2	277.6	2	Available on request
NNAMC2810PC01	NNAMC2811PC01	280.8	208.5	286.3	3.5	v1.38	280.8	268.1	286.3	3.5	Available on request
NNAMC2880PC01	NNAMC2881PC01	288	208.5	292	2	v1.38	288	268.1	292	2	Available on request
NNAMC2950PC01	NNAMC2951PC01	295.2	208.5	300.7	3.5	v1.38	295.2	283.0	300.7	3.5	Available on request
NNAMC3020PC01	NNAMC3021PC01	302.4	208.5	306.4	2	v1.38	302.4	283.0	306.4	2	Available on request
NNAMC3100PC01	NNAMC3101PC01	309.6	208.5	315.1	3.5	v1.38	309.6	297.9	315.1	3.5	Available on request
NNAMC3170PC01	NNAMC3171PC01	316.8	208.5	320.8	2	v1.38	316.8	297.9	320.8	2	Available on request
NNAMC3240PC01	NNAMC3241PC01	324	208.5	329.5	3.5	v1.38	324	312.8	329.5	3.5	Available on request
NNAMC3310PC01	NNAMC3311PC01	331.2	208.5	335.2	2	v1.38	331.2	312.8	335.2	2	Available on request

Product number		Measurements, Non-Extended Range (mm)					Measurements, Extended Range (mm)				
0°	**90°**	**A**	**B**	**C**	**D**	**From Firmware Version**	**A**	**B**	**C**	**D**	**From Firmware Version**
NNAMC3380PC01	NNAMC3381PC01	338.4	208.5	343.9	3.5	v1.38	338.4	327.7	343.9	3.5	Available on request
NNAMC3460PC01	NNAMC3461PC01	345.6	208.5	349.6	2	v1.38	345.6	327.7	349.6	2	v1.49 Extended Range

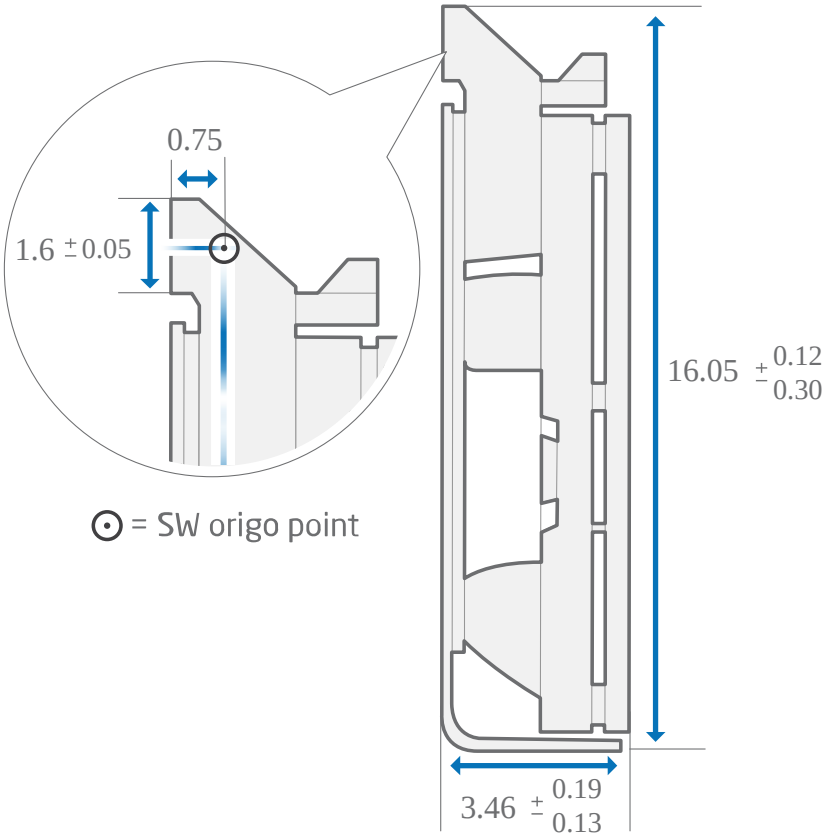
Side View

These measurements are identical for all sensor module's lenghts but vary some between the 0° and 90 ° types. The position of origin is marked with "zero software".

0° Type



90 ° Type



2.7.2 Packaging

Please refer to Packaging Blueprints in Downloads[3] for further information.

3 https://support.neonode.com/docs/display/Downloads/Packaging+Blueprints