PRODUCT CONFORMITY CERTIFICATE

This is to certify that the

Clarity Node-S

Manufactured by:

Universal Microelectronics Co. Ltd

No. 3, Gongyegu 27th Rd,
Nantun District,
Taichung City
Taiwan

has been assessed by CSA Group
and for the conditions stated on this certificate complies with:

MCERTS Performance Standards for Indicative Ambient Particulate Monitors, Environment Agency, August 2017, version 4

Certification range:

$PM_{2.5}$ 0-1,000 µg/m^3
PM_{10} 0-2,000 µg/m^3

Project No.:	80170277
Certificate No:	CSA MC230425/00
Initial Certification:	5 January 2024
This Certificate issued:	5 January 2024
Renewal Date:	4 January 2029

Andrew Young
Environmental Team Manager

MCERTS is operated on behalf of the Environment Agency by

CSA Group Testing UK Ltd
Unit 6, Hawarden Industrial Park
Hawarden, Deeside, CH5 3US
Tel: +44 (0)1244 670 900

Form 1335
Issue 11

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Approved Site Application

Any potential user should make sure, in consultation with the manufacturer, that the monitoring system is suitable for the intended application. For general guidance on monitoring techniques refer to the Environment Agency guidance available at www.mcerts.net

The indicative dust monitoring analyser(s) can be operated in one of two ways:

For qualitative measurements: Providing qualitative measurement data for the analysis of particulate pollution trends, and source identification studies based for example on pollution roses etc. Such application can rely on instrument factory calibration only.

For quantitative measurements: Providing measurement data with the uncertainty defined for indicative instruments (+/- 50%). This can be achieved on condition that each instrument used for measurement has been calibrated on the specific site where monitoring is taking place against a standard reference method for a period of two weeks and the resulting slope and intercept have been used for instrument calibration. Using non-standard filters and procedures for this purpose is not acceptable. To maintain the validity of data this calibration has to be repeated at least every twelve months or when the instrument is moved to a different site.

They **cannot** be used on national automatic monitoring networks for compliance reporting against the Ambient Air Quality Directives.

The field tests were carried out from the 10thJuly 2021 to the 29th October 2022 on two candidate 'Clarity Node-S' systems, collocated with a Palas Fidas 200 (the reference method). The location of the field test was University of Manchester, Fallowfield, Manchester, UK. The serial numbers of the two 'Clarity Node-S' systems were 'A50LXXPZ' and 'ADBJW6TG'.

Basis of Certification

This certification is based on the following test report(s) and on CSA Group's assessment and ongoing surveillance of the product and the manufacturing process:

Bureau Veritas, test report ref. AIR19404466, dated July 2023, "Test of the Clarity Node-S Sensor Systems for use as an Indicative Monitor for PM_{10} and $PM_{2.5}$"

Product Certified

The 'Clarity Node-S' measuring system consists of the following parts:

- Node-S base station, dimensions 188mm (W) x 98mm (H) x 128mm (D) includes built in antenna
- Battery embedded in the base station
- Solar Shield, dimensions (233mm (W) x 176mm (H) x 4mm (D))
- Solar Panel, dimensions (232mm (W) x 100mm (H) x 162mm (D))

Sensor type and firmware version
Plantower PMS6003, Firmware version 146 (0x92)

Firmware and Algorithm Version of the system (note 5.)
Firmware Version 2.4.1.01, Algorithm Version 1.04408

This certificate applies to all instruments with firmware 2.4.1.01 onwards. The manufacturer recommends that the user should check the firmware version to confirm prior to instrument use.

The Clarity Node-S is available as PM only and PM+NO_2 variants. Both have the same sensor type and system. No significant differences were identified during the certification testing between the two variants. Based on the certification test data it is considered that there would be no impact on the certified parameters should a device with the gas monitoring capabilities (i.e. PM+NO_2) be used for measuring $PM_{2.5}$ or PM_{10}. Certification is for $PM_{2.5}$ and PM_{10} only.

Certified Performance

Test (***Laboratory***)	Results expressed as % of the certification range				Other results	MCERTS specification
	<0.5	<1	<2	<5		
Constancy of the sample volumetric flow					Not applicable Note 1	To remain constant within ± 3%
Tightness of the sampling system			1.18%			Leakage not to exceed 2% of sampled volume

Test (**Field**)	Results expressed as % of the certification range				Other results	MCERTS specification
	<0.5	<1	<2	<5		
Intra-instrument uncertainty for the reference method						
PM_{10}					0.33µg/m^3	≤2.5µg/m^3
$PM_{2.5}$					0.25µg/m^3	≤2.5µg/m^3
Intra-instrument uncertainty for the candidate method						
PM_{10}						
All data (slope corrected, n=460)					0.91µg/m^3	≤5µg/m^3 for all data as well as for the subsets: < or ≥ 30 µg/m^3
≥ 30 µg/m^3 (slope corrected, n=4)					1.29µg/m^3	
< 30 µg/m^3 (slope corrected, n=456)					0.90µg/m^3	
$PM_{2.5}$						
All data (slope corrected, n=460)					0.94µg/m^3	≤5µg/m^3 for all data as well as for the subsets: < or ≥ 30 µg/m^3
≥ 18 µg/m^3 (slope corrected, n=10)					1.24µg/m^3	
< 18 µg/m^3 (slope corrected, n=450)					0.93µg/m^3	
Highest resulting uncertainty estimate comparison against data quality objective (Measurement Uncertainty)						W_{CM}≤50% $W_{CM} \leq W_{dpo}$ (W_{dpo} Measurement uncertainty defined as 50% for indicative instruments)
PM_{10}						
All data (slope corrected) (n=460)					19.1% (note 2)	
≥ 30 µg/m^3 (slope corrected) (n=4)					21.2%	
$PM_{2.5}$						
All data (slope corrected) (n=460)					14.8% (note 3)	
≥ 18 µg/m^3 (slope corrected) (n=10)					28.2% (note 3)	
Maintenance Interval					≥2 weeks Note 4	≥2 weeks

Note 1 - The Clarity Node-S utilises a fan and not a pump, therefore it was agreed that this test was not applicable.
Note 2 - This data was slope corrected by dividing by 1.681. All users must slope correct PM_{10} data by dividing by 1.681. Alternatively, site specific calibration can be applied using the manufacturer's recommended procedure. The manufacturer recommends that co-location is carried out prior to each sensor being deployed for a minimum of 30 days.
Note 3 - This data was slope corrected by dividing by 1.998. All users must slope correct the $PM_{2.5}$ data by dividing by 1.998. Alternatively, site specific calibration can be applied using the manufacturer's recommended procedure. The manufacturer recommends that co-location is carried out prior to each sensor being deployed for a minimum of 30 days.
Note 4 - Maintenance - the manufacturer states that no routine maintenance is required in the field. The system raises an alarm when the Node-S system operational status has degraded. Users are instructed to carry out the trouble-shooting, should this be unsuccessful, the Node-S system should be replaced.
Note 5 - For the system to be used for indicative purposes the Clarity Node-S must be set up using the configuration, as follows; i) Plantower PMS6003 sensor type with firmware version '146 (0x92)', and ii) the system algorithm version: 1.04408 and firmware version 2.4.1.01.

Description

The Clarity Node-S is an air quality sensor. The Node-S comes pre-configured with integrated solar power harvesting, batteries, and global cellular connectivity.

As the Node-S device samples the air, measurements are continuously uploaded to the Clarity Cloud via cellular networks. This cloud architecture handles all aspects of air quality data transmission, validation, storage, and processing. Access of the raw and calibrated data can be done through the Clarity Dashboard and APIs.

General Notes

1. This certificate is based upon the equipment tested. The Manufacturer is responsible for ensuring that on-going production complies with the standard(s) and performance criteria defined in this certificate. The manufacturer is required to maintain an approved quality management system controlling the manufacture of the certified product. Both the product and the quality management system shall be subject to regular surveillance according to 'Regulations Applicable to the Holders of CSA Group Testing UK Ltd Certificates'.

2. The design of the product certified is defined in the CSA Group design schedule V00 for certificate no. CSA MC230425/00.

3. If a certified product is found not to comply, CSA Group should be notified immediately at the address shown on this certificate.

4. The certification marks that can be applied to the product or used in publicity material are defined in 'Regulations Applicable to the Holders of CSA Group Testing UK Ltd Certificates'.

5. This document remains the property of CSA Group and shall be returned when requested by CSA Group.