

Product **HS20 laser**
Serial number **94G284**
Date of calibration **6th March 2021**

Calibration certificate

Specification **Vacuum wavelength** 0.6329905770 μm ± 0.1 ppm
Equivalent frequency 473612829.2 MHz

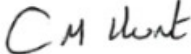
Measured values and uncertainties of calibration



Results	Value (MHz)	Value (ppm)
Laser frequency:	473612824.9	-
Laser frequency error:	-0.4	-0.001
Stability (peak-to-peak):	1.3	0.003
Maximum laser frequency error:	-1.1	-0.002
Uncertainty of measurement (k=2):	± 5.9	± 0.01

Reference standards	Ref. no.	Lab	Certificate no.	Calibration date
Iodine stabilised HeNe laser	RUK27030	NPL	2017050069-LL03	24 th May 2017
Frequency counter	RUK25619	UKAS0152	U308558	20 th April 2020
Reference HeNe laser	XL-80 REF16	Renishaw	86H571-210223-00	23 rd February 2021
Test procedure	WI-10840			

Laser measurement system accuracy: Based on this calibration, when this HS20 is used with a Renishaw RCU10 compensator and a Renishaw air temperature sensor (*both within specification*) the laser measurement system accuracy (k=2) in linear measurement mode will be within: ± 1.0 ppm (see the system manual for details).

Authorised signature	Signatory	Position	Issue date
	Chris Hunt	General Manager	6 th March 2021

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Certificate number
94G284-210306-00

L-9908-0888/04

Calibration notes

1. **Lasers (XM, XL, ML, HS and RLU)** are calibrated by comparison to a reference HeNe laser using an optical beat frequency technique. Reference lasers are routinely calibrated against an iodine-stabilised HeNe laser supplied by the National Physical Laboratory (NPL), or by a national standards laboratory. All frequency measurements are taken over a 1 hour period.
2. **Air pressure and relative humidity (RH) sensors are installed in a compensator (XC and RCU).**
The air pressure sensors are calibrated over 650 mbar to 1150 mbar range in a temperature controlled oven by direct comparison with a reference pressure meter. The RH sensors (where fitted) are certified by the manufacturer to be within specification. They are calibrated by comparison of the readings with those from a reference RH meter at a single applied humidity.
3. **Air and material temperature sensors (XC and RCU)** are calibrated by direct comparison with transfer platinum resistance thermometers (PRTs) in a temperature controlled water bath over 0 °C to 40 °C (50 °C for material sensor). The transfer PRTs are routinely calibrated against reference PRTs.
4. **Rotary axis calibrators (XR20)** are calibrated using a HeNe laser angular interferometer.
5. **Ballbar transducers (QC20-W and QC10)** are calibrated using a HeNe laser interferometer. The scale factor (QC10 only) is calculated and must be entered into the Renishaw application software prior to use.
6. **Ballbar calibrators** are calibrated by direct comparison with a reference ballbar calibrator (calibrated by a national standards laboratory) using a reference ballbar as a transfer standard. The measured values for the ballbar calibrator must be entered into the Renishaw application software prior to use.
7. **Traceability.** All the reference standards (listed overleaf) used in these calibrations are traceable either directly to major international metrology institutes who have signed the CIPM Mutual Recognition Agreement (e.g. NPL: UK; LNE: France; NIST: USA; PTB: Germany; NMIJ: Japan) or to a national accreditation body (e.g. UKAS: UK; A2LA: USA).
8. **Environment.** The equipment used for calibration is in a facility held between 15 °C and 25 °C.
9. **Uncertainty calculations.** The uncertainty calculations have been carried out according to the European Co-operation for Accreditation document EA-4/02.
10. **Quality accreditation.** All calibrations above are covered by Renishaw's ISO 9001 quality assurance system. The system is audited and certified by an accredited agency.
11. **Re-calibration.** Customers may wish to confirm that systems are performing within published specifications over time. If so, it is recommended that they should be periodically re-calibrated. Please note that compensators and temperature sensors are re-calibrated only at a single applied temperature, air pressure and humidity. Please refer to the appropriate system manual for further details.