



Miniature Spectrometer

Technical specifications

Ref: MSP-ISI-TEC 001-02

Date: 2017-05-05

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Technical Specifications

This document shows the technical specifications of the MSP1000 miniature spectrometer. Further information can be found on the IS-Instruments [website](#), where you can also find the user manual and download the user software.

| Specification | Value |
|---|---|
| Optical | |
| Wavelength range | From <390 nm to >850nm. |
| Resolution (FWHM) | <2nm across full range (50 µm diameter core fibre). |
| Exposure time | 2 ms — 1 seconds |
| Fibre input | SMA 905 |
| Fibre NA | 0.22 |
| Thermal stability | Δ0.4 nm/°C |
| Read noise | 50 counts (Max. Standard deviation) |
| Stray Light | < 2% @ 633 nm |
| Linearity | > 98 % (corrected) |
| Electronics | |
| Connectivity | Ethernet WiFi (optional) – Hotspot mode, or connect to user WLAN |
| Supply voltage | 4.75 — 5.25 V |
| Max acquisition rate | 10 Hz |
| Mechanical | |
| Dimensions | 59×108×131 mm |
| Weight | Approx 500 g |
| Storage and working environment | |
| Temperature | 0 — 40 °C |
| Humidity | noncondensing |
| Software | |
| Windows/Mac OS X, 32/64-bit Connection via simple protocol (Python, etc) Each MSP1000 has a unique 64-bit ID allowing multiple units on the same network. | |

Table 1. MSP 1000 technical specification summary

Example Spectra

The MSP1000 is capable of acquiring high resolution spectra of many different targets. Figure 1 shows some example spectra, acquired using the standard spectrometer configuration (600 lpm grating) with a 25 μm fibre. The solar spectrum was acquired using an MSP1000 with a windowless detector, showing the characteristic blackbody curve and clear Fraunhofer absorption lines.

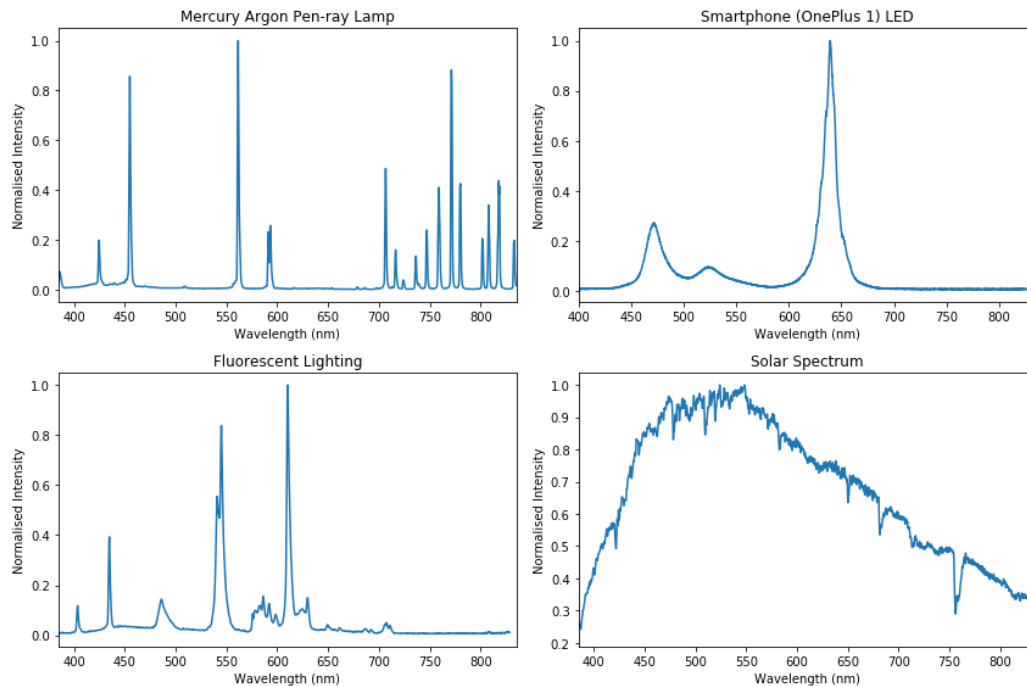


Figure 1. Example spectra as individually labelled obtained using the MSP1000 in standard configuration

Software

The MSP1000 is supplied with easy-to-use software for acquiring spectra and performing common tasks like dark subtraction, averaging and peak detection.

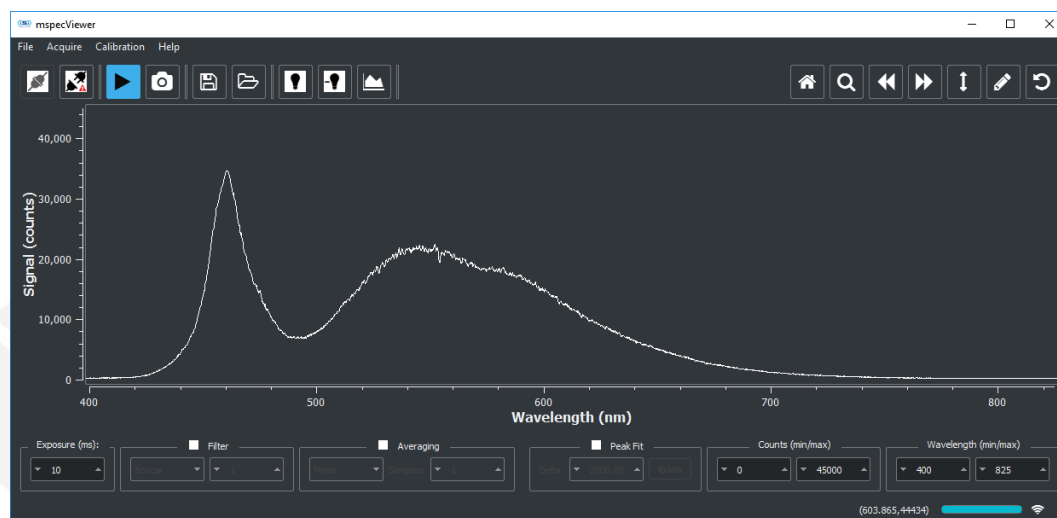


Figure 2. Screenshot of MSP1000 operating software

Detector Spectral Response

The MSP1000 uses a Toshiba TCD1304 linear array CCD detector. The spectral response of this sensor is shown in Figure 3 below. Note that performance below 400 nm will be degraded due to both the quantum efficiency (QE) of the detector and the attenuation of standard optical fibres (which are specified between 400-2200 nm).

On request, we can supply the MSP1000 with a UV-coated, windowless, detector which improves the sensitivity down to 150 nm if a suitable fibre is used.

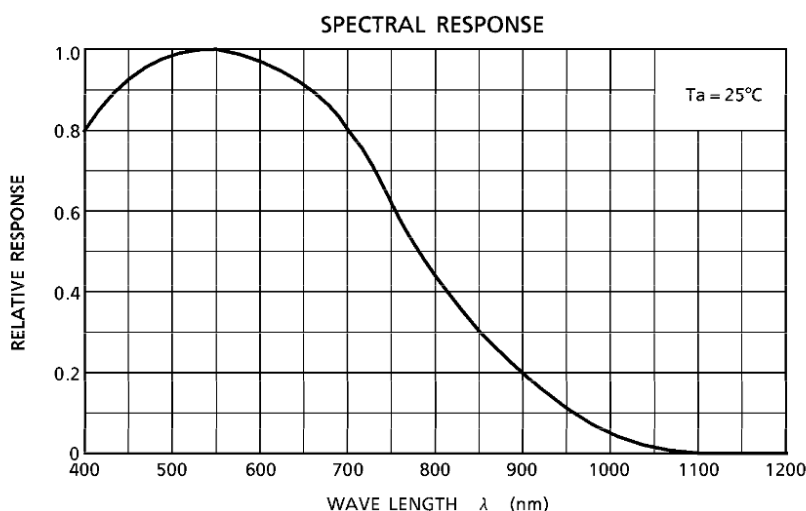


Figure 3. Spectral response of Toshiba TCD1304 linear array CCD detector

MSP1000 Customisation

The standard configuration is a windowed TCD1304 CCD, 600 line/mm grating (500 nm blaze) and a spectral range of 400-850 nm (shown in **bold** in Table 2 and Table 3). Other grating and CCD options are available on request (see Table 2 and Table 3).

Diffraction gratings

| Lines / mm | Blaze angle (nm) | Spectrum width (approx.) (nm) | Typical range* (nm) | Approx. FWHM, 25 um fibre (nm) |
|------------|------------------|-------------------------------|---------------------|--------------------------------|
| 300 | 500 | 900 | 200-1100† | 3 |
| 600 | 500 | 450 | 400-850 | 1.5 |
| 1200 | 500 | 225 | 400-625 | 0.75 |
| 600 | 750 | 450 | 525-975 | 1.5 |
| 1200 | 750 | 225 | 625-875 | 0.75 |
| 600 | 1000 | 450 | 700-1100 | 1.5 |
| 1200 | 1000 | 225 | 875-1100 | 0.75 |

Table 2. Summary of available diffraction grating options and resultant spectral widths, ranges and resolutions

* Standard range, can be modified on request

† < 400nm if using a UV coated detector

The grating angle determines spectral range; for the standard MSP1000, a 600lpm grating is used and set to give a range of between 400-850 nm. The MSP1000 is a fibre-coupled spectrometer, so spectral resolution is dependent on both the combination of grating and fibre core size. A slit is not required (the effective slit width is the fibre core diameter). The blaze angle represents where the diffraction grating efficiency is highest, so for a NIR applications, a 1000 nm blaze is more appropriate than 500 nm.

For FWHM calculations, we assume a peak width of 3 px and a resolution factor of 1.5 (for a 25 um fibre). The CCD pixel size is 8x200 um.

CCD Customisation

| CCD Type |
|--------------------|
| Windowed TCD1304 |
| Windowless TCD1304 |
| UV/Other Coatings |

Table 3. CCD type options available with MCP1000

Uncoated, windowed, CCDs exhibit a characteristic ‘etalon’ effect when observing broadband spectra (see Figure 4 below). This is due to multiple reflections caused by near-monochromatic light on the detector cover glass window. Customers should choose a windowless CCD if they need to observe the specific shape of spectral features. A windowless CCD is not required for reflectance or absorption measurements (or any other relative intensity measurement), as the CCD response is cancelled out. Alternatively, this effect can be removed via calibration if a known white light source is available. Note that a windowless detector does not affect the quantum efficiency (wavelength sensitivity) of the CCD, but it will slightly improve the amount of light received.

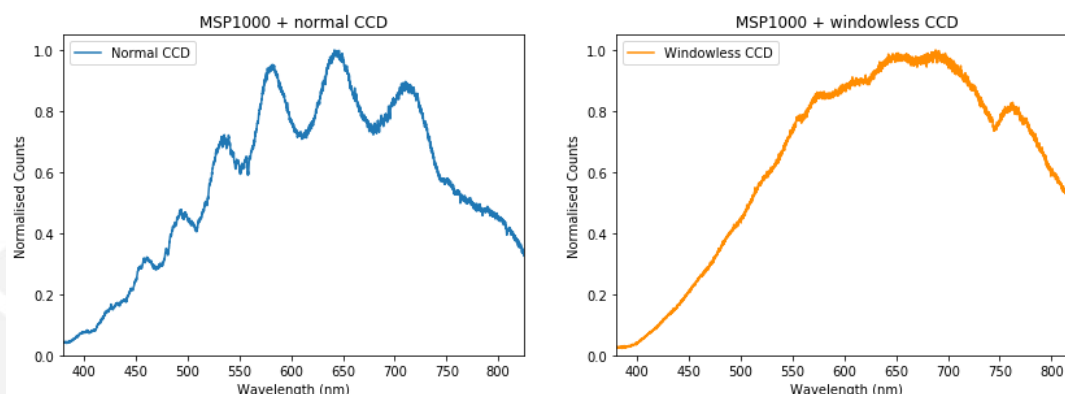


Figure 4. Spectrum of a tungsten halogen lamp using a 25 um fibre acquired using MSP1000 windowed and windowless detectors.

Calibration

Each MSP1000 is wavelength-calibrated against a Mercury-Argon line source. The calibration coefficients are stored on the device and can be updated via the control software if required. We do not perform a radiometric calibration as this would only be valid for a fixed experimental setup. If you wish to make absolute intensity measurements, you should use a calibrated broadband light source (e.g. tungsten halogen lamp) to obtain the radiometric correction for your spectrometer on a per-experiment basis.

Optional Accessories (please enquire)

| Accessory |
|---------------------------------|
| Compatible WiFi dongle |
| Ethernet cable |
| 50 mm Integrating sphere 3-port |
| 50 mm Integrating sphere 4-port |
| Cuvette holder |

Table 4. Accessory options available with MSP1000

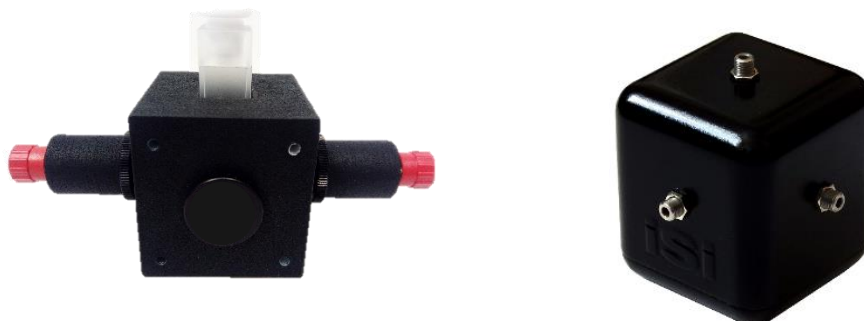


Figure 5. (Left) Low cost cuvette holder, shown with two fibre ports and blanking plate installed. (Right) Low cost integrating sphere with three fibre ports visible.

The cuvette holder accepts standard 12.5 mm cuvettes. It features up to four collimated fibre ports and is compatible with industry-standard 30 mm cage systems. An M4 threaded hole on the base allows for easy mounting on optical posts or plates.

Integrating spheres are available with a 50 mm diameter and 3 or 4 fibre ports. There is an M4 thread on the base for post mounting. These spheres are coated with [Avian-B](#), and have >92% reflectance between 250-1300 nm and >97% reflectance between 350-850 nm.

For more information about accessories, please contact IS Instruments.

Mechanical Drawings

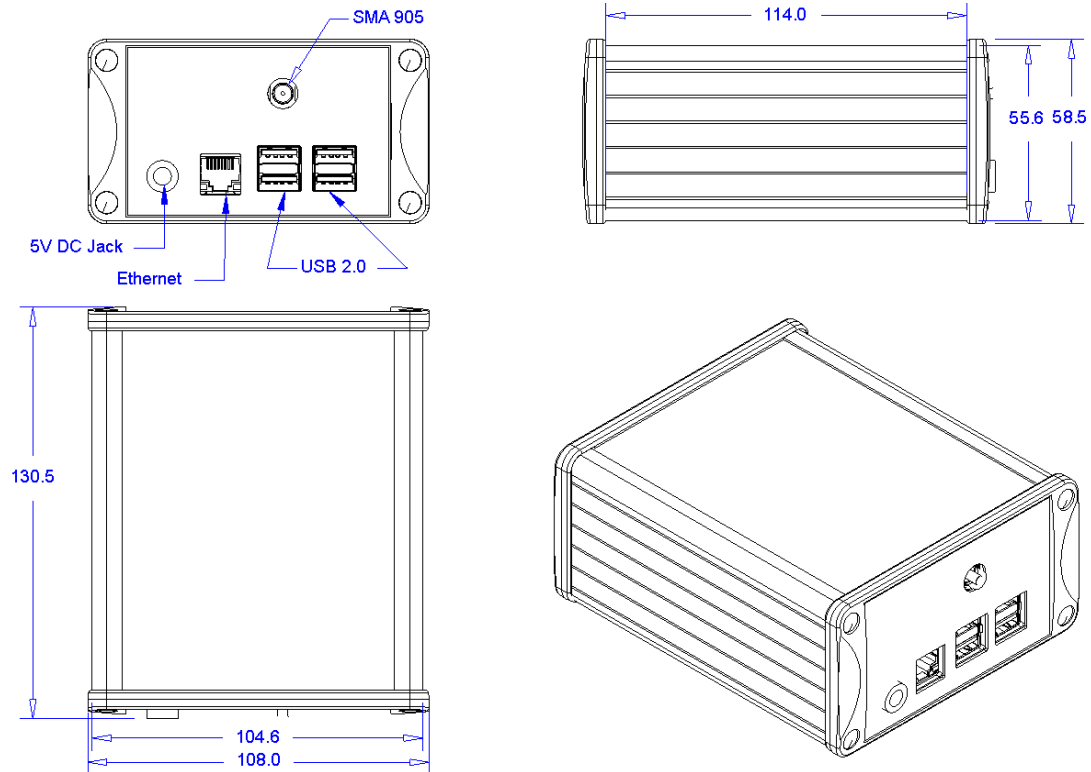


Figure 6. MSP1000 Mechanical drawing. All dimensions are given in millimetres.

Rubberised feet are attached to each unit for stability on bench surfaces. This adds around 5mm to the height. If you do not wish the feet to be attached, please specify before ordering.