
LED Station / MAS40

Mini Array Spectrometer

User Manual

Version 1.1

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Typographic Conventions

Before you start using this guide, it is important to understand the terms and typographical conventions used in the documentation.

The following kinds of formatting in the text identify special information.

Formatting convention	Type of Information
Bold	Items you must select, such as menu options, command buttons, or items in a list.
<i>Italic</i>	Use to emphasize the importance of a point or for variable expressions such as parameters. Furthermore, all filenames and paths are typed in italics.
CAPITALS	Names of keys on the keyboard. For example, SHIFT, CTRL, or ALT.
KEY+KEY	Key combinations for which the user must press and hold down one key and then press another, e.g. CTRL+P, or ALT+F4.
<div style="border: 1px solid black; background-color: #cccccc; padding: 2px; display: inline-block;">grey box</div>	Information in such a box is particularly important for your safety, the reliable operation of the instrument and/or accurate measurement results.

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Introduction

The *LED Station* is a system that was specially designed for the measurement of LEDs. The central idea behind the *LED Station* is the simple, but precise measurement of LEDs. This idea has been consistently implemented in this product:

- The optical probe is directly flange-mounted and is simple to exchange
- The instrument is connected to the PC via USB
- The *SpecWin light* software is intuitive to operate

To complete the system, Instrument Systems provides the *LED720* LED current source for the precise power supply of the LED under test. The *LED720* can be remotely controlled from *SpecWin light* by USB.

You can also measure the spatial radiation characteristics of your LEDs by integrating the *MiniGon* goniophotometer in your *LED Station*. This is also controlled by the *SpecWin light* software via USB.

As the spectrometer, the *MAS40* is the heart of the *LED Station*. Naturally, it can also be used on its own. The PLG adapter can be used to connect to the extensive range of accessories from Instrument Systems.

Please read this operating manual carefully before operating the device for the first time!

Safety instructions

The commissioning and operation of the *LED Station / MAS40* may only be carried out by authorized qualified personnel. Please also pay attention to the enclosed safety regulations and read the operating manual before putting the instrument into operation.

This instrument left the factory in a safe and secure technical condition. The continuing failure-free function and operational safety of the instrument can only be guaranteed if the user follows the instructions and warning notes that are contained in this operating manual during its use.

No claim can be accepted under the warranty if the instrument was damaged or destroyed by the effect of static discharges, humidity, fire, electric shocks or similar. Furthermore, the warranty expires if the instrument is opened by persons who have not been authorized to do so by INSTRUMENT SYSTEMS GmbH. The warranty claim is also invalid if the instrument shows any signs of mechanical damage after delivery.

Never look directly into the optical probes, fibers or PLGs. There could be dangerous radiation coupled in from the other side.

Operating conditions:

The permissible ambient temperature range during operation ranges from +15°C to +35°C. During storage or transport, the temperature may vary between 0°C and +50°C. If condensation forms during transport or storage, the instrument must be acclimatized for at least 2 hours before it is put into operation. The instrument is intended for use in clean, dry premises. It must not be operated at particularly high levels of dust or humidity in the air, or if there is a danger of explosion, or under the influence of aggressive chemical effects. Ensure an adequate circulation of air.

To prevent dew forming on the sensor, do not exceed the maximum humidity of 70%rF.

Under no circumstances may the *MAS40* be operated if unusual effects occur during operation such as, e.g. large increases in temperature or strong odors.

Instructions for maintaining measurement accuracy

The *MAS40* contains high-precision optical and electronic components. In order to retain its accuracy, the instrument must not be subjected to vibrations or jolts. Thus, the *MAS40* must only be transported in its original packaging.

The calibration interval is normally 1 year. Under difficult operating conditions, i.e. if the *MAS40* has been subjected to contamination (surrounding air) or large temperature fluctuations, calibration should take place at shorter intervals.

Cleaning and maintenance

First switch off the instrument by removing the USB plug.

Only clean the outside of the instrument with a dry or lightly moistened cloth. Only use pure water or mild detergent.

The instrument does not contain any user-repairable parts.

Instrument description

LED Station

Scope of delivery

The *LED Station* comprises the following parts:

- *MAS40*
- Optical probe (brightness adapter and/or ISP75 integrating sphere)
- Base plate
- *SpecWin light* software
- USB cable
- Diskette containing configuration and calibration files
- Dummy plugs for all optical probes and the *MAS40*
-

Optional:

- Density filter (in holder)
- PLG adapter
- Additional optical probes
- LED test socket(s)
- LED 720 LED current source
- MiniGon goniophotometer

Please check if the scope of delivery is complete when you unpack the instrument.

Instrument installation and transport

The *MAS40* of the *LED Station* is built on a solid base plate. The bottom of the base plate is provided with non-slip rubber feet.

The instrument should be operated in a horizontal position and is specified for this position.

Do not expose the instrument to direct heat or direct sunlight in its operating position.

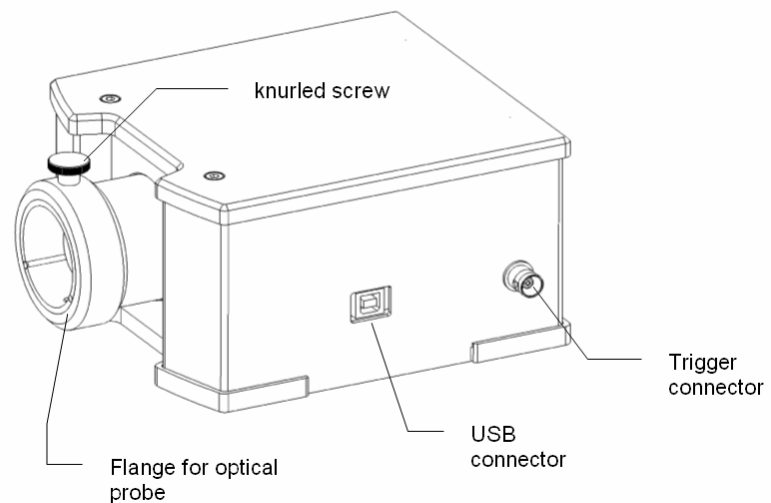
To protect the optical probes during transport, they should be removed before transport. To protect the optical components from dust, all unused parts of the *LED Station* should always be protected with the cover provided.

Connections and operating elements

The MAS 40 has its own USB jack connection. The cable that is supplied is used to connect the MAS 40 with the PC.

The trigger connector is a standard BNC jack. Please refer to the trigger section for more information.

The instrument has no additional operating elements. The power supply is provided by the PC USB jack.



The MAS40 can be mounted on the provided base plate. Use the provided screws to mount the MAS40 onto the base plate. By using the base plate the stability of the MAS40 with mounted optical probe is enhanced.

Configuration file

The configuration file contains important information on the features of your *MAS40* and its wavelength calibration. The PC software may supply incorrect measurement results or not function at all if the configuration file is missing or incorrect. Therefore, we recommend making a backup of the configuration file supplied with your *MAS40*.

The configuration and calibration files are supplied on a floppy disk together with the instrument.

The configuration file always has the filename `Serialnumber.ini` (e.g. `123040L1.ini`). Each combination of the spectrometer and optical probe has its own configuration file. Also, if you have several probes for your spectrometer, you must use the relevant configuration file for each probe. Which file belongs to which probe is given in the enclosed test certificate.

When you install *SpecWin light* the configuration and calibration files are copied to your harddisk and referenced in the ini-file of the software.

Calibration file

The second important file for the operation of the *MAS40* is the calibration file. This file contains the spectral and absolute calibration of the instrument. The calibration file always has the filename `Serialnumber.isc` (e.g. `123040L1.isc`).

The PC software will supply incorrect measurement results if the calibration file is missing or incorrect. Thus, we recommend making a backup of the calibration file supplied with your *MAS40*. Each combination of the spectrometer and optical probe has its own calibration file. Also, if you have several probes for your spectrometer, you must use the relevant calibration file for each of the probes. Which file belongs to which optics is given in the enclosed test certificate.

When you install *SpecWin light* the configuration and calibration files are copied to your harddisk and referenced in the ini-file of the software.

MAS40

Scope of delivery

The scope of delivery of the *MAS40* includes the following parts:

- *MAS40*
- PLG adapter
- Optical probe with fiber and PLG
- Diskette with configuration and calibration files
- USB cable
- Screw cap to cover the optical input
- Software on diskettes or CD

Optional:

- Density filter (in holder)
- Additional optical probes

Please check if the scope of delivery is complete when you unpack the instrument.

Instrument installation and transport

The instrument should be operated in a horizontal position and is specified for this position. The bottom of the *MAS40* is provided with non-slip rubber feet and should be placed on a level surface.

Do not expose the instrument to direct heat or direct sunlight in its operating position.

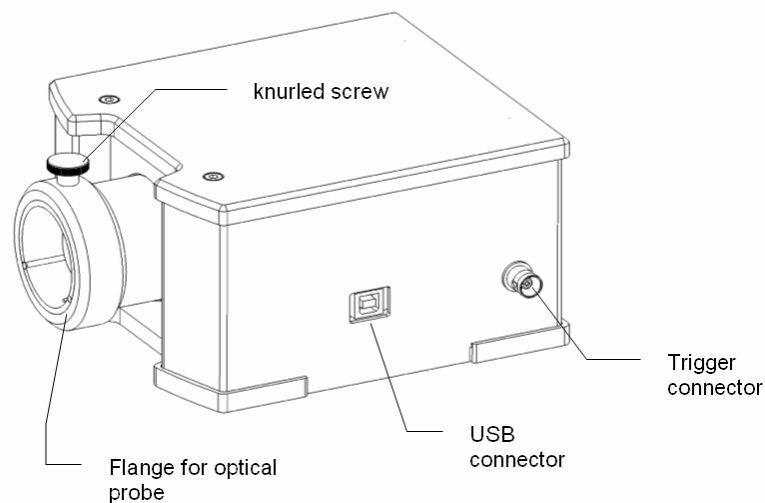
The PLG adapter, which is included in the scope of delivery of the *MAS40*, can always remain on the instrument. When the instrument is not in use or during transport, the screw cap supplied should be used to cover the optical input.

Connections and operating elements

The MAS 40 has its own USB jack connection. The cable that is supplied is used to connect the MAS 40 with the PC.

The trigger connector is a standard BNC jack. Please refer to the trigger section for more information.

The instrument has no additional operating elements. The power supply is provided by the PC USB jack.



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The PC software will supply incorrect measurement results if the calibration file is missing or incorrect. Thus, we recommend making a backup of the calibration file supplied with your *MAS40*. Each combination of the spectrometer and optical probe has its own calibration file. Also, if you have several probes for your spectrometer, you must use the relevant calibration file for each of the probes. Which file belongs to which optics is given in the enclosed test certificate.

When you install *SpecWin light* the configuration and calibration files are copied to your harddisk and referenced in the ini-file of the software.

Commissioning the instrument

Software installation

The software must be installed before the instrument is connected to the PC for the first time.

The standard software for the LED Station and the *MAS40* is *SpecWin light*. To install the software, execute the *Setup.exe* file on the CD provided. To carry out the installation, follow the details of the installation routine.

Please pay attention to the information in the *readme.txt* file. This file contains additional up-to-date information regarding the current software version. Further information is given in the software documentation.

To install other software (e.g. *MAS40.dll* or *SpecWin*), please follow the instructions that were delivered with the software.

Keep the diskettes containing the configuration and calibration files on hand during the installation of the *SpecWin light* software. These files will be copied onto the PC hard disk during the installation.

If you have connected the instrument to your PC before you have installed the software, please use the driver file (.inf-file) stored on the enclosed driver floppy. Follow the instructions of the driver installation wizard of the operating system.

Hardware installation

The software installation automatically installs all the drivers required for operation.

When the software has been installed and the computer has been restarted (Windows98 and Me only), you can connect the *MAS40* to a free USB jack on the computer. Windows automatically recognizes the spectrometer and configures the previously installed driver. The spectrometer is now ready for operation.

Working with the LED Station

Dark current measurements with the MAS40

The *MAS40* uses a CCD sensor to convert light into current. The dark current is a signal delivered by the sensor, even if there is no light falling on it. This signal depends on the temperature, the integration time and the number of averages.

Each time the measurement parameters (integration time and number of averages) are changed, the dark current must be determined again. For a simple and streamlined working method, before the first measurement the software creates a table containing the dark current for the various parameters. This table is then used for the respective parameter as follows. To keep the measurement duration for this dark current measurement within limits, this table will be constructed for only up to 1.7 sec integration time, i.e. for integration times greater than 1.7 sec before a measurement with changed parameters, a dark current measurement must be carried out. The software automatically requests you to make a dark current measurement. To keep dark current measurements as simple as possible, close the optical probe with the supplied dummy plug.

Before making the first dark current measurement, connect the instrument to the USB connection on your running computer for approximately 15 mins to ensure the instrument reaches the operating temperature.

You can determine the dark current measurement again at any time using the **Measure | Dark Current Measurement** command in *SpecWin light*.

Tips for the correct selection of the measurement parameters

Measurement time (integration time):

To ensure a good output from the detector the measurement parameter integration time can be changed. This value represents the measurement time (in msec) for which the sensor is illuminated. Only afterwards is the array read out. This measurement time is comparable with the exposure time of a camera used for photography. We recommend an output of approx. 3000 to 4000 counts (incl. dark current signal) for the 12-bit ADC that is used. The signal-to-noise ratio of the measurement signal increases linearly with the measurement time. The usable range of the MAS40 is 4msec to 20sec. However, it is important to note that, in the case of very long measurement times of more than approx. 4sec, the noise of the sensors is higher and the usable dynamics are decreased due to the dark current of the sensor.

IS-SpecWin (light) integrates an auto ranging function that automatically selects a convenient integration time. We recommend using this function because it ensures optimum spectra.

Measured value averaging (Averaging):

As well as the increase of the integration time, the increase in the number of averagings ("Averaging") can also be used to improve the signal-to-noise ratio. However, at the same time, the signal-to-noise ratio only increases with the square root of the number of averagings since, in contrast to the integration time, this involves a purely statistical effect. It follows that the optimum measurement time should be determined first and only then the number of averagings to achieve the required signal-to-noise ratio.

Triggering the MAS40

The MAS40 features a trigger input that can be used for external triggering of the MAS40.

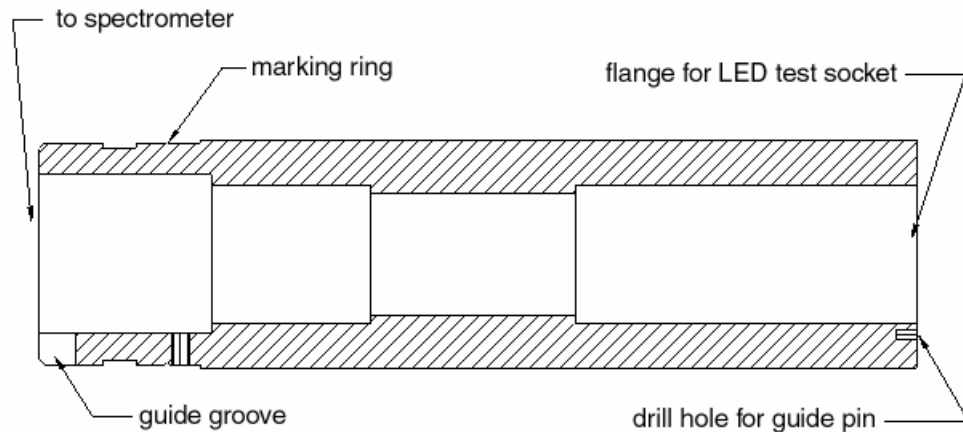
The triggering options of the MAS40 are quite basic. The trigger is a level trigger that means that the trigger signal (TTL, high active) needs to be relatively long. To achieve reliable triggering the trigger signal should be around 50msec long. The exact start of the measurement can not be determined.

Options of the LED Station

Luminous intensity adapter

The light intensity adapter is directly flange-mounted onto the *LED Station*. It complies with the CIE norm ILED_B. This means that a detector with an area of 1cm² is positioned at a distance of 100mm from the LED.

This adapter is used for the measurement of the light intensity of LEDs. To do so, the LED is mounted in an Instrument Systems test socket. The test socket is designed so that it fits directly into the receptacle of the light intensity adapter and the correct distance is automatically maintained. Instrument Systems has suitable test sockets for a wide range of different LEDs.



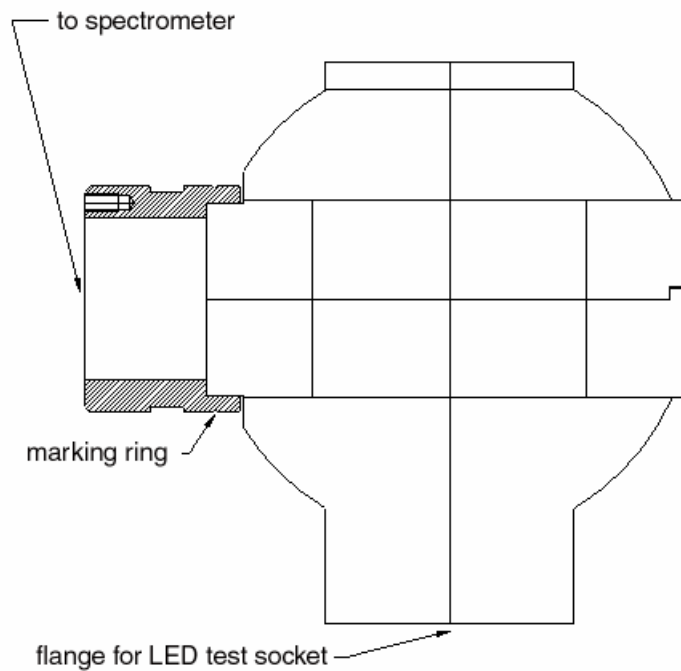
The light intensity adapter is calibrated together with the *MAS40* and thus, together with the spectrometer, forms a single unit. The calibration is not lost if the adapter is removed and correctly (page 18) mounted again.

Please note that the light intensity adapter should be covered when it is not in use to prevent dust reaching the optical elements.

ISP75 integrating sphere

Like the light intensity adapter, the ISP75 is directly flange-mounted onto the *MAS40*. The ISP75 is used for the measurement of the light current of LEDs. Naturally, it can also be used to measure other light sources that are small enough to be measured. The opening in the integrating sphere is 7mm in the standard version.

As in the case of the light intensity adapter, the LED is mounted in a Instrument Systems test socket.



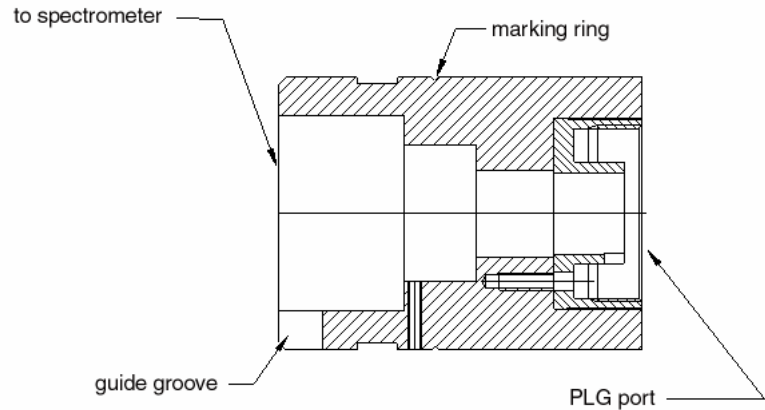
The ISP75 is calibrated together with the *MAS40* and thus, together with the spectrometer, forms a single unit. The calibration is not lost if the integrating sphere is removed and is correctly (page 18) mounted again.

Please note that the ISP75 should be covered when it is not in use to prevent dust reaching the optical elements.

PLG adapter

In addition to the two optical probes (the light intensity adapter and the ISP75) specially developed for the *LED Station*, the so-called PLG adapter is also available. This enables connection to the full accessories program of Instrument Systems.

This is always connected to the spectrometer via an optical fiber. The PLG is used to couple the radiation from the fiber to the spectrometer as loss-free as possible.



Please note that, using the PLG adapter and LED430 luminous intensity adapter, the entire system is approximately a factor 5 less sensitive than an *LED Station* with a directly flange-mounted luminous intensity adapter.

The possible connections using the PLG adapter are described in the chapter concerning the options of the *MAS40*. (page 25)

Replacing the optical probes

The optical probes - luminous intensity adapter or integrating sphere - of the *LED station* are directly flange-mounted onto the *MAS40*.

To connect one of the optics, proceed as follows:

1. The side that is inserted into the spectrometer is marked with an aluminium colored ring. This ring also indicates whether the optical probe is inserted far enough into the flange.
2. Hold the optic so that the guiding groove points downwards.
3. Carefully insert the optical probe into the flange.
4. Unscrew the knurled screw on the flange until the optical probe no longer strikes against it.
5. Push the optical probe into the flange up to the stop. The marking must just disappear below the flange.
6. Hold the optical probe approximately horizontally and tighten up the knurled screw. Do not use too much force. The optical probe must be held stable but the screw must not be tightened up too forcefully.

Option for increased sensitivity

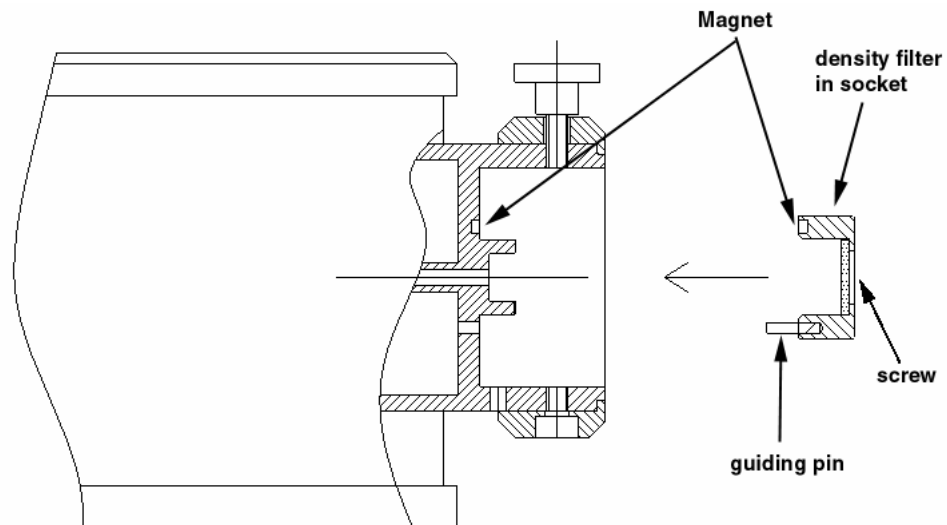
The MAS40-210 option can be used to increase the sensitivity of the spectrometer by a factor of 10. This option is permanently installed in the instrument and therefore its use is not selectable. Please note that this also reduces the maximum measurable intensity by a factor of 10.

Using density filters

Density filters can easily be used on the *MAS40*. With the insertion of density filters, the sensitivity range of the spectrometer is extended upwards. It is sometimes necessary in order to be able to measure an especially bright component.

A holder for the inclusion of a density filter is incorporated in the flange that holds the optical probe. Density filters from Instrument Systems are available as an option for the *MAS40* and are mounted in a special socket.

To insert a density filter in the instrument, remove the optical probe and simply plug the density filter into the receptacle in the *MAS40*. The socket of the filter is guided by an alignment pin and is held by magnetic force. The filter must be inserted as shown in the figure below.



To insert the density filter place the guiding pin into the hole below the receptacle and push the density filter socket over the receptacle until the mechanical stop is reached.

When you permanently use the density filter or transport the instrument with the density filter attached to the instrument you should use the screw to fasten the density filter.

When using a filter, please be careful not to touch it.

The transmission of the density filter must be known in order to furnish the correct measurement result. This takes the form of an absolute factor that is saved in the calibration file of the spectrometer. In order to set up the software so that a measurement with a filter can be used, select the filter to be used in the respective drop-down box of the measurement parameter dialog.

MiniGoniophotometer

To determine the spatial radiation characteristics of an LED, the MINIGON mini-goniophotometer was developed. This goniophotometer is specially adapted to the *MAS40* and is also controlled by the software SpecWin light. A special base plate is provided that enables the spectrometer to be simply flange-mounted to the goniometer for operation of the MINIGON with the *MAS40*.

The MINIGON is also controlled via the USB interface.

LED 720 current source

The LED720 current source is used for the precision supply of power to the LEDs. Like the *MAS40*, it can also be remotely controlled via USB.

The current source is distinguished by an extremely constant output current that is continuously adjustable between 0 and 50mA (via USB in 12 μ A steps).

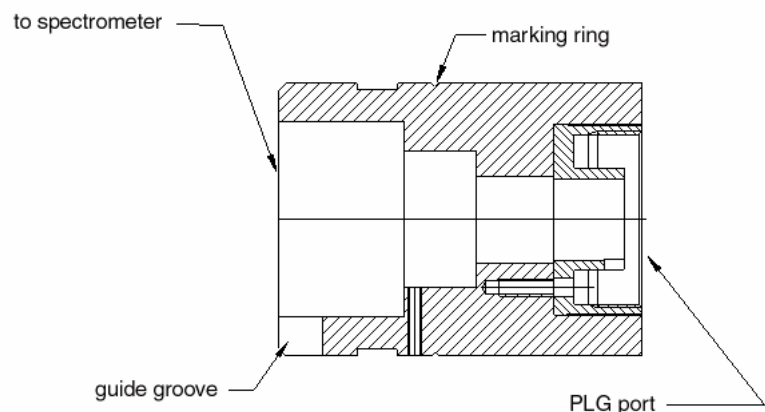
Working with the MAS40

Mounting and removal of the optical probe

The so-called PLG adapter is used to connect the fiber optic of the optical probe to the spectrometer.

To attach the PLG adapter to the spectrometer, proceed as follows:

1. The side that is inserted in the spectrometer is marked with an aluminium colored ring. This ring also indicates whether the PLG adapter is inserted far enough into the flange.
2. Hold the PLG adapter so that the guide groove points downwards.
3. Carefully insert the PLG adapter into the flange.
4. Unscrew the knurled screw from the flange until the PLG adapter no longer impacts against it.
5. Push the PLG adapter into the flange up to the stop. The marking must just disappear into the flange.
6. Hold the PLG adapter approximately horizontally and tighten the knurled screw. Do not use excessive force. The PLG adapter must be held firmly, but the screw must not be tightened with too much force.



When the equipment is delivered, the PLG adapter is already mounted. The adapter can always be left attached to the instrument.

When the equipment is not in use, leave the adapter mounted on the spectrometer and keep the input closed with the screw cap supplied.

To connect the fiber optic to the PLG adapter, remove the screw cap from the PLG optical probe and insert the PLG into the optical probe. Ensure that the guidance pin of the PLG clicks into the groove of the PLG adapter. Only then can a reproducible mounting of the fiber optic on the spectrometer be achieved. Finally, tightly screw the knurled ring threaded on the fiber onto the PLG adapter to secure the optical fiber.

Dark current measurements with the MAS40

The *MAS40* uses a CCD sensor to convert light into current. The dark current is a signal delivered by the sensor, even if there is no light falling on it. This signal depends on the temperature, the integration time and the number of averages.

Each time the measurement parameters (integration time and number of averages) are changed, the dark current must be determined again. For a simple and streamlined working method, before the first measurement the software creates a table containing the dark current for the various parameters. This table is then used for the respective parameter as follows. To keep the measurement duration for this dark current measurement within limits, this table will be constructed for only up to 1.7 sec integration time, i.e. for integration times greater than 1.7 sec before a measurement with changed parameters, a dark current measurement must be carried out. The software automatically requests you to make a dark current measurement. To keep dark current measurements as simple as possible, close the optical probe with the supplied dummy plug.

Before making the first dark current measurement, connect the instrument to the USB connection on your running computer for approximately 15 mins to ensure the instrument reaches the operating temperature.

You can determine the dark current measurement again at any time using the **Measure | Dark Current Measurement** command in *SpecWin light*.

Tips for the correct selection of the measurement parameters

Measurement time (integration time):

To ensure a good output from the detector the measurement parameter integration time can be changed. This value represents the measurement time (in msec) for which the sensor is illuminated. Only afterwards is the array read out. This measurement time is comparable with the exposure time of a camera used for photography. We recommend an output of approx. 3000 to 4000 counts (incl. dark current signal) for the 12-bit ADC that is used. The signal-to-noise ratio of the measurement signal increases linearly with the measurement time. The usable range of the *MAS40* is 4msec to 20sec. However, it is important to note that, in the case of very long measurement times of more than approx. 4sec, the noise of the sensors is higher and the usable dynamics are decreased due to the dark current of the sensor.

IS-SpecWin (light) integrates an auto ranging function that automatically selects a convenient integration time. We recommend using this function because it ensures optimum spectra.

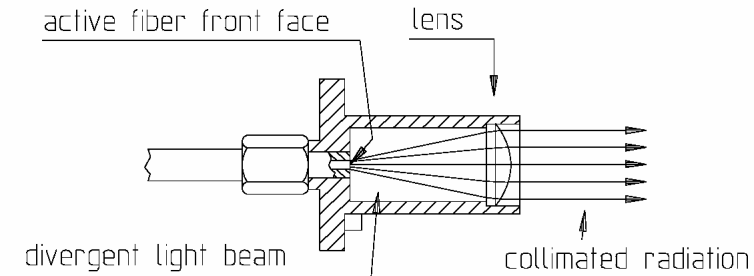
Measured value averaging (Averaging):

As well as the increase of the integration time, the increase in the number of averagings ("Averaging") can also be used to improve the signal-to-noise ratio. However, at the same time, the signal-to-noise ratio only increases with the square root of the number of averagings since, in contrast to the integration time, this involves a purely statistical effect. It follows that the optimum measurement time should be determined first and only then the number of averagings to achieve the required signal-to-noise ratio.

Radiation coupling via optical fiber

The PLG adapter enables the connection of the *MAS40* to the range of accessories from Instrument Systems. These accessories are always connected to the spectrometer via fiber optics.

Different fiber optic adapters (PLG) are available. These consist essentially of the connecting piece for a standardized fiber optic connector and of a collimating lens system, which collimates the divergent rays emerging from the fiber.



The illustration shows an example of a PLG for a mono fiber with SMA connection. The same principle is also used for fiber bundles with ferrule connections.

The fiber plug adapter is pushed into the coupling optical probe of the PLG adapter, and screwed with the knurled ring onto the inlet opening.

Provided external optical probes from INSTRUMENT SYSTEMS are used, the radiation coupling is coupled with an SMA plug connection via either a mono fiber or a fiber bundle with ferrule.

If a fiber plug adapter is used, it must be noted that the factory calibration for the measurement of the optical radiant power can only be carried out for one single connector adapter in each case.

The unit made up of optical probes, fibers and PLG may not be separated as, otherwise, the calibration would be lost.

Triggering the MAS40

The MAS40 features a trigger input that can be used for external triggering of the MAS40.

The triggering options of the MAS40 are quite basic. The trigger is a level trigger that means that the trigger signal (TTL, high active) needs to be relatively long. To achieve reliable triggering the trigger signal should be around 50msec long. The exact start of the measurement can not be determined.

Options of the MAS40

Option for increased sensitivity

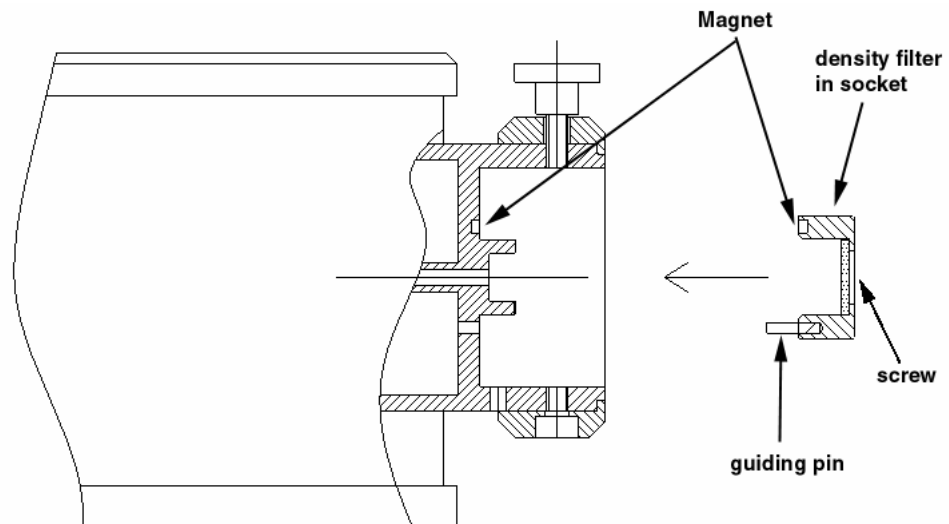
The MAS40-210 option can be used to increase the sensitivity of the spectrometer by a factor of 10. This option is permanently installed in the instrument and therefore its use is not selectable. Please note that this also reduces the maximum measurable intensity by a factor of 10.

Using density filters

Density filters can easily be used on the *MAS40*. With the insertion of density filters, the sensitivity range of the spectrometer is extended upwards. It is sometimes necessary in order to be able to measure an especially bright component.

A holder for the inclusion of a density filter is incorporated in the flange that holds the optical probe. Density filters from Instrument Systems are available as an option for the *MAS40* and are mounted in a special socket.

To insert a density filter in the instrument, remove the optical probe and simply plug the density filter into the receptacle in the *MAS40*. The socket of the filter is guided by an alignment pin and is held by magnetic force. The filter must be inserted as shown in the figure below.



To insert the density filter place the guiding pin into the hole below the receptacle and push the density filter socket over the receptacle until the mechanical stop is reached.

When you permanently use the density filter or transport the instrument with the density filter attached to the instrument you should use the screw to fasten the density filter.

When using a filter, please be careful not to touch it.

The transmission of the density filter must be known in order to furnish the correct measurement result. This takes the form of an absolute factor that is saved in the calibration file of the spectrometer. In order to set up the software so that a measurement with a filter can be used, select the filter to be used in the respective drop-down box of the measurement parameter dialog.

Spectral radiometric measurements with the optical probes EOP-xxx and ISP40-10x

Absolute spectral radiometric measurements are possible using the optical probes of the EOP-XXX series. These are connected with the optical input of the equipment via an optical fiber and via a fiber connector adapter.

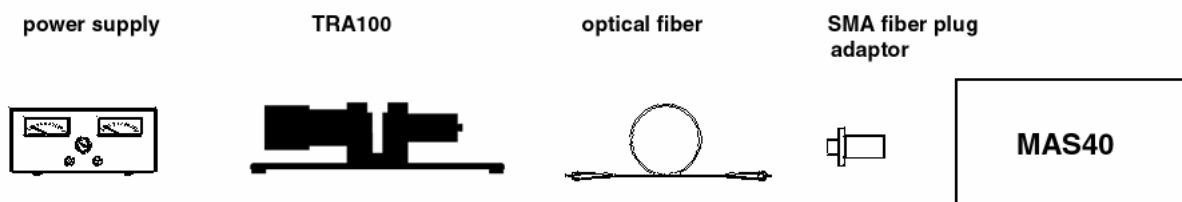
Please note that for calibrated optics neither the optical probe nor the fiber connector adapter must be removed from the fiber as otherwise the calibration can be lost.

For most applications, optical probes of the types EOP-120 and EOP-140 that provide a good compromise between diffuser attenuation and high light throughput are recommended.

Very good cosine reception characteristics are shown by the optical probes EOP-410 and ISP40-10x. However, in these probes, the light losses are higher.

Transmission measurements

INSTRUMENT SYSTEMS offers the TRA100 transmission measurement adapter for transmission measurements on optical filters or other transmittive optical media. The connection of this test adapter to the instrument is realized using fiber optics.



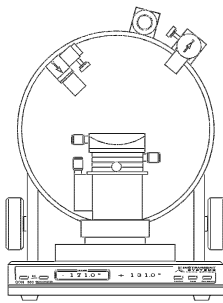
At the beginning of the measurements, the component to be tested must be removed from the beam path and a reference measurement carried out. The software now sets this "empty spectrum" to 100%. From now on, each measurement is made with respect to the reference measurement.

Ensure that the spectral limits for the measurement are selected so that at least 5% intensity is present compared with the peak intensity when recording the reference spectrum.

This avoids excessive levels of noise at the edges of the spectrum.

Reflection measurements with the GON360 goniometer

The GON 360 goniometer enables spectral measurement of transmission and reflection for different angles of incidence and emergence.



GON360

An optical fiber feeds the beam from a light source (e.g. LS100 from INSTRUMENT SYSTEMS) to the illumination optics, where it is collimated (and possibly polarized) and guided to the probe surface. A measuring optics records the beam coming from the sample and directs it via fiber optics to the MAS40.

A large variety of optical tables and adjustment elements allow simple handling of the sample. The angle of incidence and angle of emergence can be adjusted by a choice of manual control or PC control using motors.

The current angular position can be read on a display with a resolution of 0.01°.

Measurement of diffuse reflection with the ISP80 integrating sphere

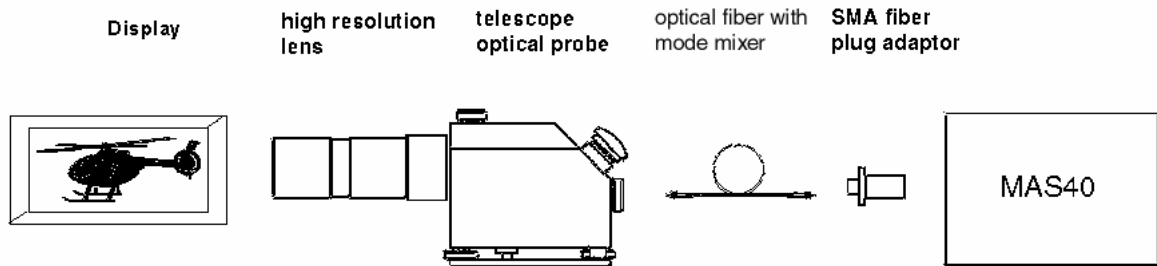
The ISP80 integrating sphere enables diffuse reflection (and also transmission) measurements. This is a measurement adapter with a modular construction that can be connected directly to the optical input of the MAS40, or externally via an optical fiber bundle.

A large number of accessories, e.g. various baffle plates, are also available.

A display test system based on the MAS40

Displays are an essential component of modern instruments and vehicles. The specification and quality assurance of these elements has an ever increasing significance for manufacturers and users.

A combination of the TOP 100 telescope optics from INSTRUMENT SYSTEMS and a spectrometer produces a display test system.



Different measuring spot size can be realized by using different objective lenses on the TOP100 :

Objective lens	60mm	HRL90
Aperture 1	0.25mm at 80mm 2.1mm at 500mm	0.15mm
Aperture 2	0.5mm at 80mm 4.2mm at 500mm	0.3mm
Aperture 3	1mm at 80mm 8.4mm at 500mm	0.6mm

Detailed information can be obtained from the brochure or in the TOP100 handbook.

Technical data

LED Station

Optical properties

Pixel count	2048
Integration times	4msec...20sec
Spectral range	LED40-100 (VIS): 320...800nm LED40-110 (VIS (NIR): 380...950nm LED40-120 (UV): 200 -600nm
Spectral resolution ¹	2.5nm
Wavelength accuracy ²	±0.5nm
Stray light (broadband with standard illuminant A) ³	LED40-100 (VIS): 2×10^{-3} at 400nm LED40-110 (VIS (NIR): 2×10^{-3} at 400nm LED40-120 (UV): 2×10^{-3} at 285nm
Stray light (for LED) ⁴	6×10^{-4}
Linearity	±2.5%

Luminous intensity

Measurement range ⁵	0.4mcd...4cd
Measurement accuracy ⁶	±7%

Luminous flux

Measurement range ⁵	20mlm...200lm
Measurement accuracy ⁶	±7%

Spectral measurements

Measurement accuracy for dominant wavelength ⁷	±1nm
Measurement accuracy for chromaticity (x,y,z) ⁷	±0.005

General data

Interface	USB
AD converter	12-bit
Dimensions (w, h, d)	145mm x 90mm x 185mm (spectrometer only)
Power consumption	650mW (via USB)
Operating conditions	Surrounding temperature 10...35°C; relative humidity 70%
Weight	2.1kg (spectrometer only)

- 1 Valid for the 50µm slit. Optional are 25µm and 100µm slit available
- 2 Valid for Penray lamp or laser
- 3 Measured with cut filter 320nm for 285nm measurement location or 455nm for 400nm measurement point
- 4 Measured at 100nm distance to the left of the peak wavelength, relative to peak intensity of the unweighted spectral data
- 5 Measured at 600nm wavelength and signal to noise ratio of 10:1 and without averaging. With the MAS40-210 option, the sensitivity is a factor 10 higher
- 6 Immediately after calibration relative to calibration standard
- 7 With sufficient signal dynamics and after calibration. The specifications apply a twofold standard deviation.

MAS40

Optical properties

Pixel count	2048
Integration times	4msec...20sec
Spectral range	MAS40-100 (VIS): 320...800nm MAS40-110 (VIS (NIR): 380...950nm MAS40-120 (UV): 200 -600nm
Spectral resolution ¹	2.5nm
Wavelength accuracy ²	±0.5nm
Stray light (broadband with standard illuminant A) ³	LED40-100 (VIS): 2×10^{-3} at 400nm LED40-110 (VIS (NIR): 2×10^{-3} at 400nm LED40-120 (UV): 2×10^{-3} at 285nm
Stray light (in LEDs) ⁴	6×10^{-4}
Linearity	±2.5%

Spectral radiometry

Sensitivity range for irradiance ⁵	1×10^{-5} ...0.1W/m ² nm
Signal sensitivity at 1s integration time ⁵	5×10^{-4} W/m ² nm
Spectral radiometric accuracy ⁶	±7%

Spectral photometry

Baseline noise ⁷	±0.7%
Photometric transmission accuracy ⁸	±1%
Baseline drift ⁸	0.5%/h

General data

AD converter	12-bit
Interface	USB
Dimensions (w, h, d)	145mm x 90mm x 185mm (spectrometer only)
Power consumption	650mW (via USB)

Operating conditions Ambient temperature 10...35°C; relative humidity 70%

Weight 2.1kg (spectrometer only)

1 Applies to 50µmslit. 25µm and 100µm slits are available as options

2 Applies to penray lamp or laser

3 Measured with cut filter at 320nm for 285nm measuring point or 455nm for 400nm measuring point

4 Measured at 100nm distance to the left of the peak wavelength, relative to peak intensity of the unweighted spectral data

5 Measured with optical probe EOP120 and fiber bundle OFG414, at a wavelength of 500nm and signal-to-noise ratio of 10:1 and without averaging. With the option MAS40-210, the sensitivity is a factor of 10 higher

6 Immediately after calibration relative to calibration standard

7 At 50msec integration time, ADC level >3000counts, without averaging. The use of 10 averages reduces noise by a factor of 3.

8 Applies for LS100-130 light source after 1h warm-up time

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