Astro Hutech®

Hutech Astronomical Products
Equipment for the Serious Amateur Astronomer

Light Pollution Suppression (LPS) Filters

Home

Placing Orders

Filter Price List

Main Price List

Light pollution suppression (LPS) filters are designed to suppress the common mission lines generated by artificial lighting, yet allow the important nebula emission lines to pass, thus enhancing the contrast of astronomical objects, particularly emission nebulae (see **filter plots** to see the effect on light pollution emission bands). The most recently introduced version (D2) has a bandpass designed to cope with the increasing trend of society's switch to LED lighting.

Unlike other light pollution suppression filters, IDAS filters are specifically designed for balanced color transmission using the IDAS unique **Multi-Bandpass Technology** (MBT) process. The balanced transmission allows color photographs to be taken with minimal color cast to broadband emission objects such as stars, galaxies and globular clusters.

LPS filters utilize the unique IDAS Ion Gun Assisted Deposition (IGAD*) coating technology for superior coating durability (quartz hardness) and safer cleaning. IGAD coatings also improve temperature and humidity stability of the filter performance, reducing spectrum shifts down to +/-1nm from the +/-3 or 4nm shift of standard coatings. [More about IDAS filter production]

CCD imaging can also benefit, because although CCD imagers can already shoot through light pollution to some extent, including an LPS filter to the setup gives an added (signal-to-noise) edge as shown in these CCD examples (comparison testing by G. Tomita in Tokyo).

Additional independent tests and reviews are available here:

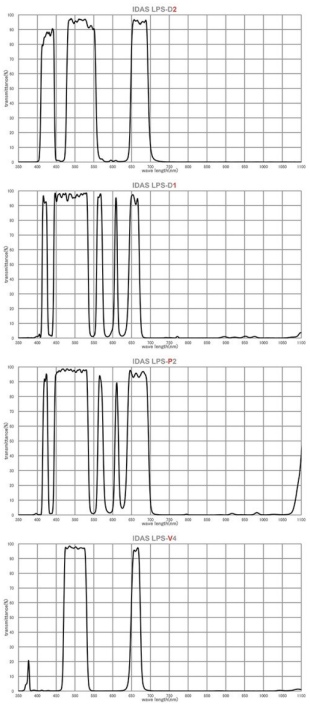
- Kazuyuki Tanaka's tests
- Sky & Telescope Review - "Light Pollution Filters for Cameras" (June 2001).

Note, however, that light pollution suppression filters are not a perfect substitute for dark skies. Refer to our discussion of the limitations and common misconceptions about light pollution suppression filters.

LPS filters are available for 1-1/4" and 2" (48mm) eyepieces, as well as in numerous sizes to accomodate most popular camera lenses. Each filter lot is tested and a plot of the spectral response of the lot is provided with each filter (see filter plot sample).

Information on Older IDAS LPS Filters:

- LPS P2 Information
- Narrow-band Nebula LPS V4 Information



Click to enlarge plots

In addition to blocking selected light pollution emission bands, IDAS filters block the range 700-1000nm to insure that silicon sensors are adequately blocked from unwanted IR. All plots shown are measured responses of production filters.

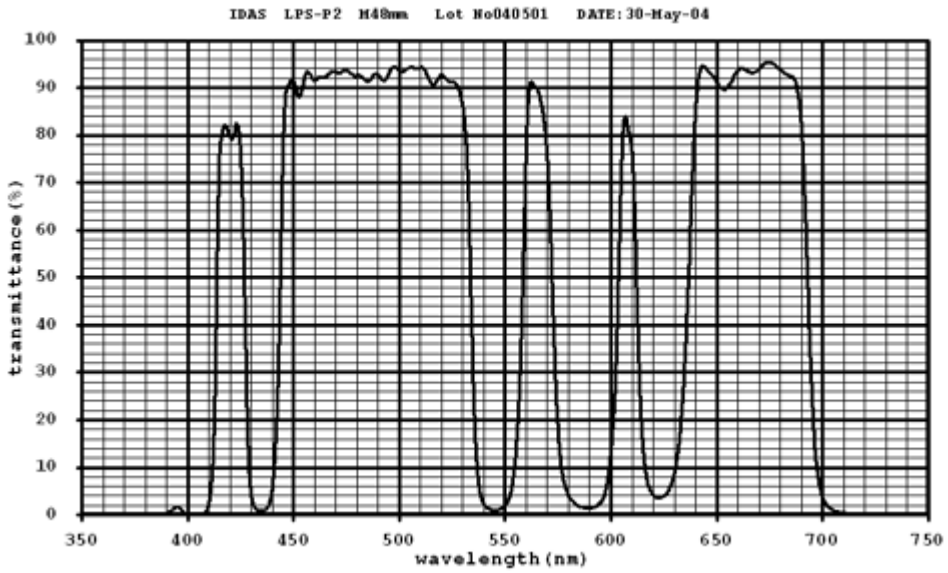
Light Pollution Suppression (LPS) Filters

Back to Filter List

Back to Light Pollution Suppression Filters

Home

Placing Orders



Above is a sample of the filter lot data plot which is shipped with each filter.

The IDAS production criteria for filters are as follows, arranged from left to right (short to long wavelength) as plotted above:

Wavelength (nm)	Pass/Block	Transmission
365	Block	6.5% max
405	Block	6.5% max
	Pass	60% min (avg)
436	Block	6.5% max
	Pass	92% min (avg)
546	Block	6.5% max
	Pass	75% min (avg)
590	Block	6.5% max
	Pass	75% min (avg)
623	Block	25% max
	Pass	80% min (avg)

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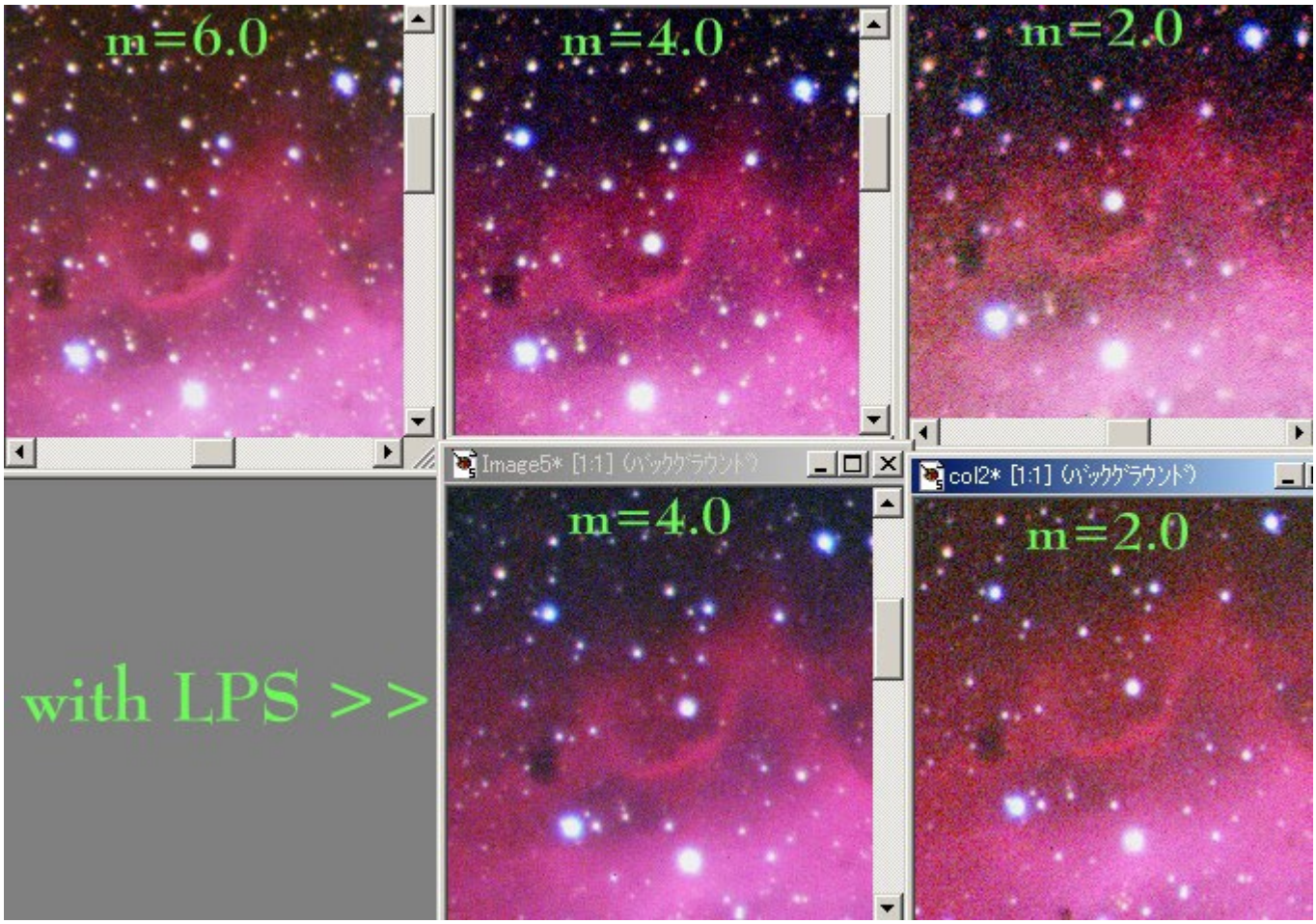
Equipment for the Serious Amateur Astronomer

IDAS LPS Filter Test (Kazuyuki Tanaka)



Shown above are photos taken with the IDAS LPS filter compared with photos taken with no filter. The "m" values given are the limiting visual magnitude at the time the photos were taken. Note the improved noise performance when the LPS filter is used. Test results are by Kazuyuki Tanaka (Arizona).

Light Pollution Suppression Filters
Limitations and Common Misconceptions

Back to Filter List

Home

Placing Orders

Light pollution suppression filters are often the topic for heated discussions among amateur astronomers because of some common misconceptions:

- **Filters make nebulae brighter.**
  This is incorrect. Filters subtract light, making objects dimmer. In the case of filters designed for light pollution suppression, wavelengths from certain types of artificial lights are blocked, but other wavelengths (particular the nebula emission lines) are allowed through, thus improving contrast. This allows longer astrophoto exposures to be made before the sky background begins to wash out the image desired. Visually, the contrast increase may be perceived to be an increase in brightness.

- **Filters make nebulae easier to see**.
  This is true only if properly used. If used in an urban environment, there are often sources of light (including the sky itself) which prevent full dark adaptation of the eye (about 30 minutes in full darkness is normally required).

- **Filters work on all objects**.
  This is not true of all light pollution suppression filters to the same degree. In general, broadband sources (galaxies, clusters, stars, or reflections of stars) will not experience as great a contrast gain as emission line objects. Filters designed for visual use or to select specific narrow emission lines (e.g. OIII) may suppress broad parts of the spectrum, decreasing the light from broadband sources even more than filters designed for balanced color photography.

- **Filters will block all light pollution**.
  This is not true. Many light sources such as car headlights are still broadband sources and will not be effectively blocked.

- **Filters increase exposure times**.
  While light pollution suppression filters will slightly increase the exposure times of emission line objects in their bandpass and affect broadband sources somewhat more, they do not require increasing the length of an exposure. However, because they increase the contrast of emission line objects compared to the sky background, it is usually desirable to increase exposure times to make better use of the imaging media's dynamic range.

- **Filters cause internal reflections**.
  Interference filters such as the IDAS LPS filters work by passing virtually all of the selected wavelengths through the filter layer and reflecting all other wavelengths, so they inherently do reflect the rejected light (unlike absorption filters).

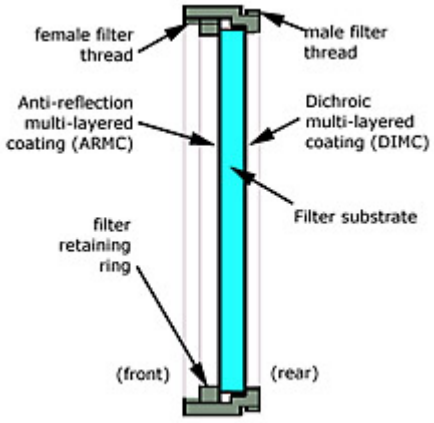
  However, this is not a problem in a high quality telescope with fully multicoated optics (all surfaces, including internal

Who needs a light pollution suppression filter?

This section of a panorama of the Milky Way is a composite of photographs taken over one evening in September 1999 from the site of the Orange County Astronomers, located near Mt. Palomar. The bright glow at the bottom is from San Diego city lights. No filter was used for this photograph.

surfaces multicoated) as the reflected components should be passed back out the scope. Low cost optics which typically omit anti-reflection coatings on internal surfaces may reflect enough light from bright objects back into the filter to cause reflections to be visible at wavelengths near the band edges. Reflections from curved optical surfaces in the telescope may also alter filter surface incidence angles enough to shift reflected components into the filter's bandpass. The solutions are to use high quality optics both ahead and behind the filter or, if possible, place the filter as far as allowed from other optical components such as a flattener or compressor.

The IDAS filters themselves are high quality optical elements and are anti-reflection multicoated on the front surface to prevent internal reflections from being a problem.



Some limitations of light pollution suppression filters should also be kept in mind:

- For photographic use, some color shift will occur because the filters do not block light in infinitely narrow bands. This affects the ratio of light in the three color bands being sampled, causing a shift in the perceived colors. The degree to which this occurs may depend not only on the filter being used, but also the type of color film used. Visually, color shifts are usually inconsequential since most extended objects will be below the eye's threshold for color detection.

- Narrowband filters are tuned to specific wavelengths by carefully controlling the thickness of layers of dielectric material on glass. Because the effective thickness changes when the filter is tilted, the wavelength tuning will also change. In practice, this means that wide-angle views will show a perceptible color shift between the center and edges of a photo.

LPS Filter: CCD Examples

Back to Filter Page

Home

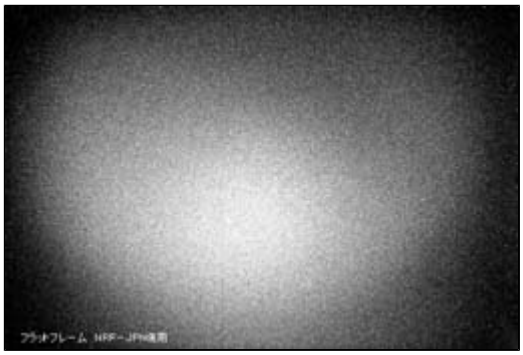
Placing Orders

Below are CCD images taken first without and then with an IDAS LPS filter (smaller images are the corresponding flat field frames). These images were taken by Mr. G. Tomita from the heavily light-polluted Tokyo metropolitan area. using an SBIG ST-8E CCD camera coupled to a Pentax 125SDHF (125mm objective, 800mm focal length) refractor. Note the improved detail in the faint areas of M27 when the IDAS LPS filter is used.

Right - flat field frame, no filter

Below - flat field frame corrected image, no filter

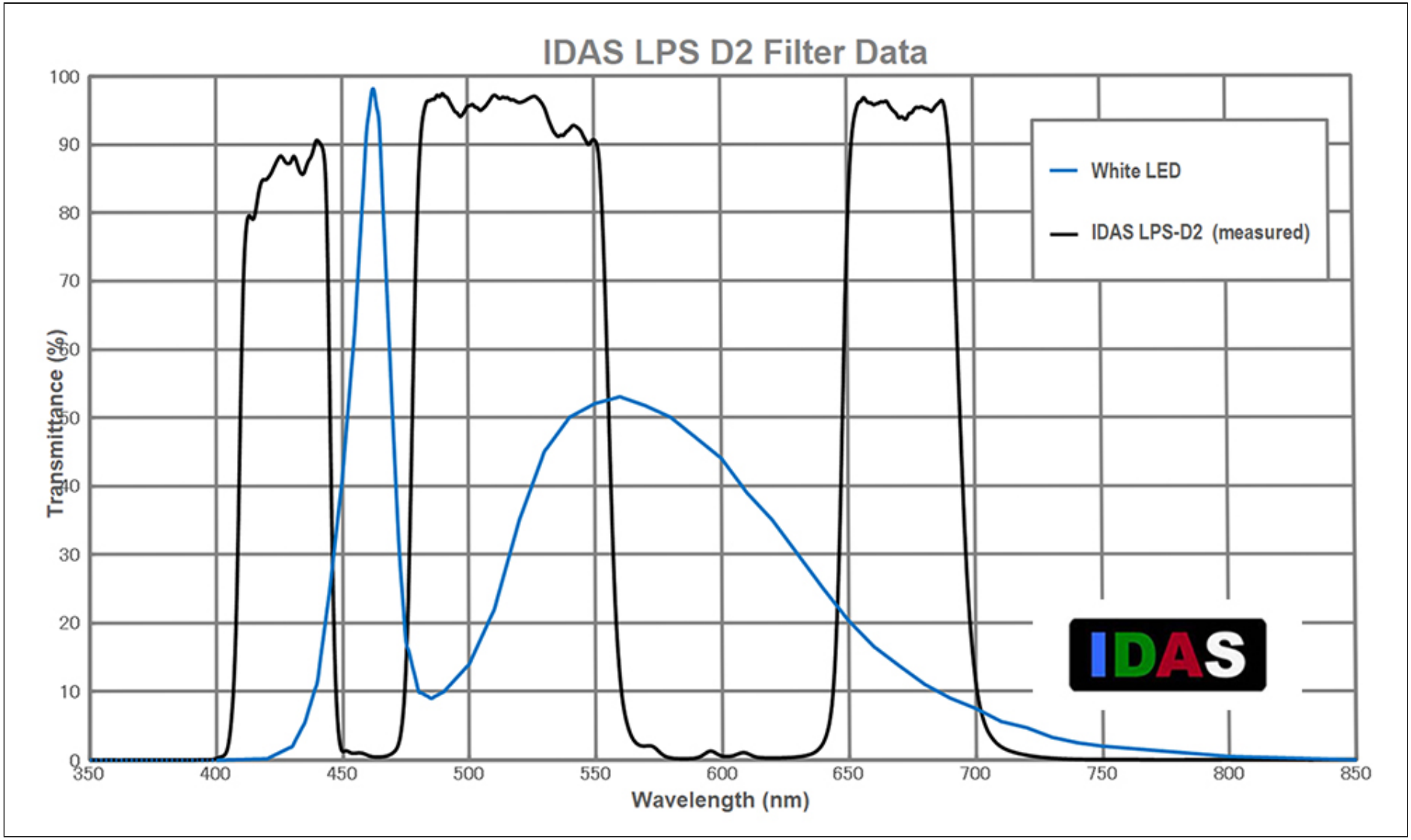
Right - flat field frame, IDAS LPS filter



Below - flat field frame corrected image, IDAS LPS filter

Hutech IDAS LPS Filters

Home



LPS D2:	White LED	HP Sodium	LP Sodium	Mercury

LPS D1:	White LED	HP Sodium	LP Sodium	Mercury
LPS V4:	White LED	HP Sodium	LP Sodium	Mercury
LPS P2:	White LED	HP Sodium	LP Sodium	Mercury

Place cursor on buttons for desired filter and light pollution source selection. Note: HP = high pressure, LP = low pressure

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Home

Placing Orders

Filter Price List

Main Price List

IDAS Filter Technology

A chain is only as good as its weakest link. This applies as well to an optical system such as a telescope/filter/imager system. With this in mind, IDAS filters are manufactured using unique technologies that result in quality that meets or exceeds that of the rest of your optical imaging system:

- **IGAD (Ion-Gun Assist Deposition)**
  This coating technology was originally developed for the optical communications field where long-term stability (>25 years) over harsh field conditions is required.

  IDAS is the first manufacturer to apply this technology to astronomical filters. This results in superior filters with robust coatings and long-term spectral stability even under temperature and humidity extremes. This stability is especially important for bandpass curves with steep slopes such as H-alpha, LPS filters, and other narrow bandpass filters. IGAD filters virtually eliminate bandpass shifts from the +/-3 or 4nm typical of standard coating filters.

- **MBT (Multi Band-pass Technology)**
  This is technology originally developed for biomedical microscopes, but improved by IDAS by combining it the IGAD hard-coating technology described above. The excellent filter responses possible with this technology allows IDAS to create very complicated filters for astronomical use such as the unique LPS filter.

- **UFP (Ultra Fine Polish) Finishing** IDAS filters are polished twice as long as is typical for optical glass. In combination with the use of high-quality substrate glass, no scratches, bubbles, or other defects are visible even under microscopic inspection.

Hutech Astronomical Products
Equipment for the Serious Amateur Astronomer

IDAS Narrow-Band Nebula (LPS-V4) Filters

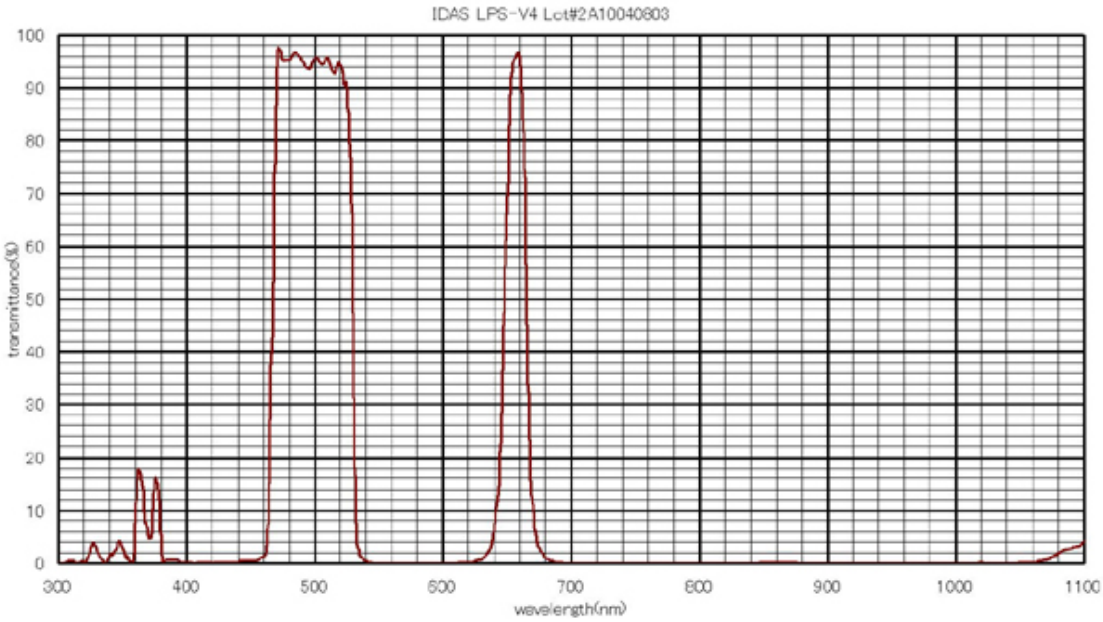
Home

Placing Orders

Filter Price List

Main Price List

The IDAS LPS-V4 filter is designed to provide maximum contrast between key astronomical emission lines and a light polluted sky. These filters incorporate IDAS MBT, UFP, and IGAD technologies to insure undegraded and extremely durable optical performance.



Features include:

- Near IR is blocked completely, eliminating the need for an additional filter to block IR.
- Narrower H-alpha bandpass.Â In combination with a Kenko R1 filter, this can be used as a 19nm bandpass H-alpha filter.
- Retains the excellent color balance of the LPS-V3 filter when one-shot color cameras are used.
- Easy creation of H-alpha enhanced color images

LPS-V4 filters are available as camera-body-mounted filters (LPS-V4-37) for Canon digital cameras or as screw-in filters for telescopes or telephoto lenses in the following sizes:

- 28.6 mm
- 48 mm
- 52 mm