

Spirit 4K

High-Performance Film Scanner and DataCine—Now With Bones Solution



Grass Valley™ products from Thomson offer production professionals the most comprehensive multi-format solutions for film acquisition, production, and post production. Grass Valley digital film products combine seamlessly to become the platform for digital intermediate, digital cinema, and video mastering applications.

With more than 250 systems shipped worldwide, the Spirit DataCine® system has been the undisputed preference for telecine and high-speed film scanning applications for nearly a decade. Now the Spirit 4K® system offers a quantum leap in performance, with a maximum native resolution of 4k and with native 2k scanning available in real time.

The Spirit 4K system is available in two basic versions: a high-performance film scanner connected to a Grass Valley Bones™ open post-production system via a high-speed Gigabyte System Network (GSN) interface, which can be upgraded to a full-featured system that includes interfaces for standard- and high-definition (SD and HD) video; and a DataCine® which includes SD and HD video outputs and which can be enhanced with a Bones system, including 4k/2k high-speed GSN data interfaces.

Spirit 4K Film Scanner/Bones Combination

Digital intermediate production—the motion picture workflow in which film is handled only once for scanning and then processed with a high-resolution digital clone that can be down-sampled to the appropriate output resolution—demands the highest resolution and the highest precision scanning.

While 2k resolution is widely accepted for digital post production, there are situations when even a higher resolution is required,

such as for digital effects. As the cost of storage continues to fall and ultra-high resolution display devices are introduced, 4k post-production workflows are becoming viable and affordable.

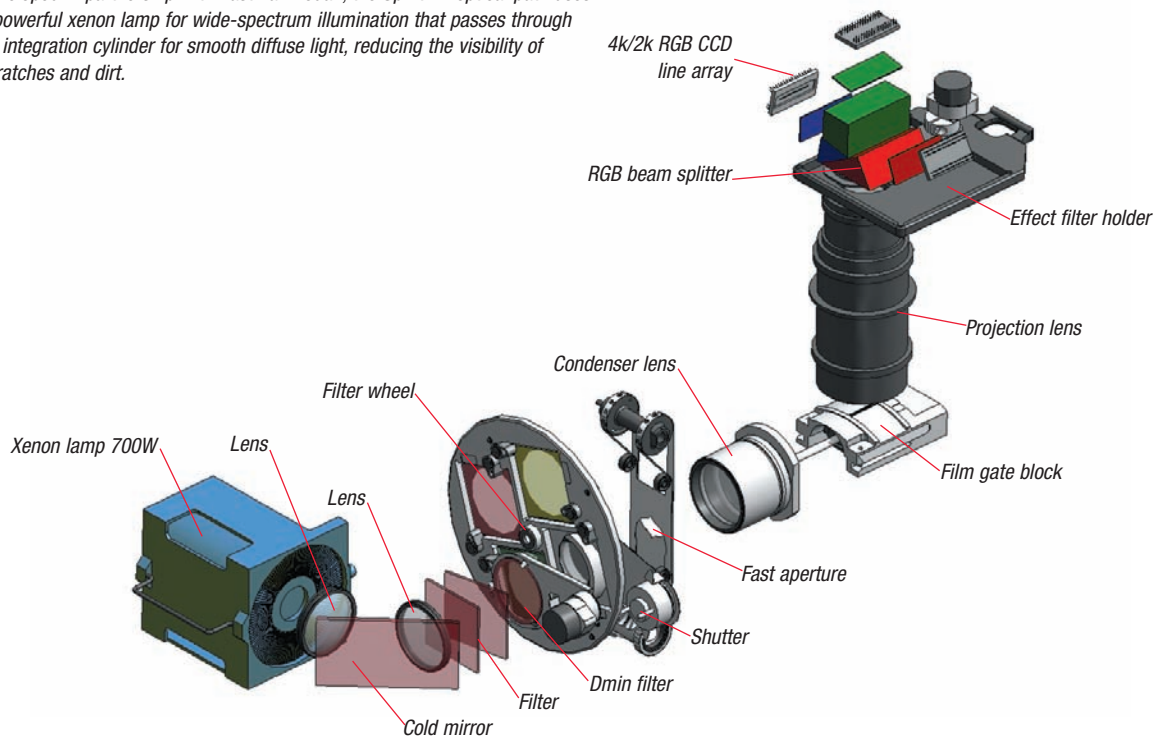
The combination of the Spirit 4K high-performance film scanner and Bones system is ahead of its time, offering you the choice of 2k scanning in real time (up to 30 frames per second) and 4k scanning at up to 7.5 fps depending on the selected packing format and the receiving system's capability. In addition, the internal spatial processor of the Spirit 4K system lets you scan in 4k and output in 2k. This oversampling mode eliminates picture artifacts and captures the full dynamic range of film with 16-bit signal processing. And in either 2k or 4k scanning modes, the Spirit 4K scanner offers unrivalled image detail, capturing that indefinable film look to perfection.

key features

- High-resolution, multi-format film scanning with unrivalled precision, stability, and image quality
- Part of market-leading Spirit line, with more than 250 systems installed worldwide
- Supports Super 35 mm, Academy 35 mm 2-perf, 3-perf, 4-perf and 8-perf (VistaVision) film as well as Standard and Super 16 mm
- Offers native 2k scanning in real time and true 4k scanning at up to 7.5 fps (depending on the selected packing format and the receiving system's capability)
- 16-bit internal processing, even at 4k
- Safe continuous-motion film transport with variable scanning speeds and visible search
- Eastman Kodak-designed advanced imaging sub-system, featuring:
 - High-power xenon illumination from a diffuse source to minimize dust and scratch visibility
 - Custom precision optics
 - Optical matching for print, negative, and intermediate stocks
 - Optical gain control
- Internal image processing including:
 - Shading correction
 - Logarithmic masking
 - RGB negative matching
 - RGB primary color correction
 - Aperture correction
- Ultra-high speed GSN optical data output
- Real-time scaling engine for conversion of 4k scans to 2k (digital oversampling)
- DPX data file format conforming to SMPTE 268M for compatibility with graphics, compositing, and other post-production systems
- Selectable transfer characteristics, including television gamma, linear, logarithmic, and user defined
- Image monitoring at up to SXGA resolution with selectable display look-up tables
- HD and SD output capabilities
- 4k/2k six-sector color processing
- 4k/2k film grain reduction

The Spirit 4K Optical Path

Developed in partnership with Eastman Kodak, the Spirit 4K optical path uses a powerful xenon lamp for wide-spectrum illumination that passes through an integration cylinder for smooth diffuse light, reducing the visibility of scratches and dirt.



Spirit 4K DataCine

Through an internal spatial processor, the Spirit 4K DataCine supports all important digital HD/DTV and SD standards in 4:4:4 and YUV formats, so you can rapidly output your material to tape or disk. In addition, you can upgrade the Spirit 4K DataCine at any time with a Bones system to deliver image files to a storage system.

Unmatched Color Performance

At the heart of the Spirit 4K system is the proven concept of a broad spectrum light source with a precision active-feedback loop to ensure consistency of image output, not just from moment to moment but across days, weeks, and months. Spirit DataCine users across the world have demonstrated that a color decision list can always be recalled with the confidence that it will be reproduced.

The Spirit 4K system uses a long-life 700W xenon lamp. Xenon illumination provides a broad and continuous spectrum of light across the entire visible area, with an emphasis in the critical short-wavelength blue area. The result is a consistently noise-free image right across the color spectrum, without problems in the blue portion that trouble other film-scanning technologies.

Like the original Spirit DataCine system, the xenon lamp output passes through an integration cylinder to create a highly diffuse light source. This diffuse light source has proved highly successful at minimizing the visible effects of film scratches and even some small dust particles.

In digital intermediate work, the normal practice is to scan the original camera negative to capture the best possible quality. The high blue content in the xenon light source of the Spirit 4K system is a significant aid in balancing out the orange mask of negative and intermediate stocks to achieve the most natural, most visually satisfying image quality.

The Spirit 4K system features new lens gate assemblies designed for Super 16 mm and full-aperture 35 mm film that are capable of scanning the Standard and Academy versions. The optical system also includes a filter drawer to allow the use of standard camera filters for optical effects during scanning.

Effective Digital Intermediate Workflow

The Spirit 4K system brings an unmatched efficiency in creating a digital intermediate (DI) from film. The unsurpassed high scanning speeds are complimented by features to support a smooth and fast scanning process.

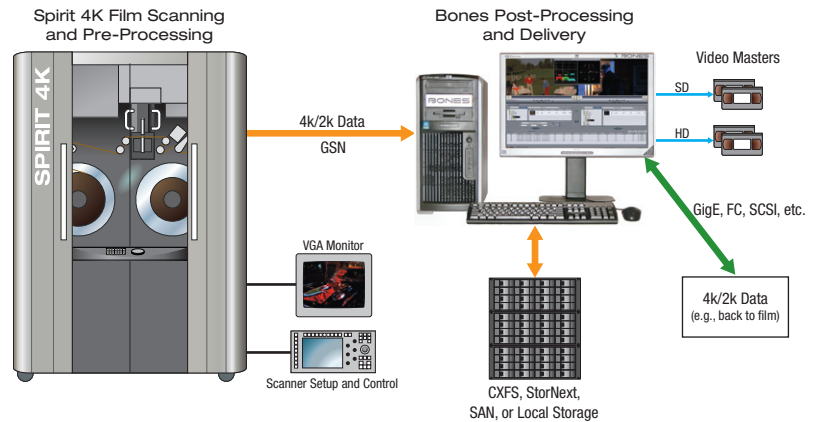
The Spirit 4K platform includes a special set of scanner menus for the graphical control panel (GCP). These menus hide typical telecine controls and restrict control to those functions required for a DI transfer. This capability reduces the risk of setting the wrong parameters during transfers, which are not supervised by a colorist.

The AutoFocus feature of the Spirit 4K system automates the focus-adjustment process and centers the focus corridor on the film emulsion. It offers a fast, easy, and accurate way of focusing at the beginning of the scanning process.

The matching process can be automated by the AutoDmin feature of the Spirit 4K system. It automatically neutralizes the color differences in the most transparent part of the film (Dmin) and sets it to the correct value for a DI transfer. In a current-settings mode the AutoDmin correction is based on density range (Dmax) settings taken from film stock or TK memories or from a user-defined Matching Lift adjustment. In a densities-settings mode you can preset the Dmax in a range of 0.1 to 3.5 densities.

Spirit 4K Application with Bones

The combination of the Spirit 4K high-performance film scanner and Bones open post-production system scans film in 2k or 4k resolution, which is then stored on disk using the Bones Transfer and Bones Mover applications. In the diagram below, the Spirit 4K system is set up with a graphical control panel (GCP), which is part of the basic scanner unit. The 4k/2k data is then post processed via the Bones system and formatted into the desired output format: data, SD, or HD.



Spirit 4K DataCine Application

The Spirit 4K DataCine scans film in 2k resolution, post processes and converts it into SD or HD output signals, controlled by a GCP and/or by a telecine controller. You can add processing such as six-sector color correction or grain reduction, as well as a Bones system to make use of the Spirit 4K system's ability to scan to data.

The PrinterLights option of the Spirit 4K system allows you to generate and store settings for numerous film stocks. Based on these film stocks and a display calibrated to a print look, color correction can be performed in printer light steps and respective feedback can be given to a director of photography.

The PrinterLights option implements the functional part of a digital Hazeltine into the Spirit 4K system. It includes the generation and storage of color-matching settings for various film stocks as a reference for the subsequent printer-lights definition in R, G, B, and master.

You can augment this special DI feature set with an event-list option for scene-by-scene corrections and the Bones system pull list support for list-controlled transfers based on frame count, timecode, or keycode.

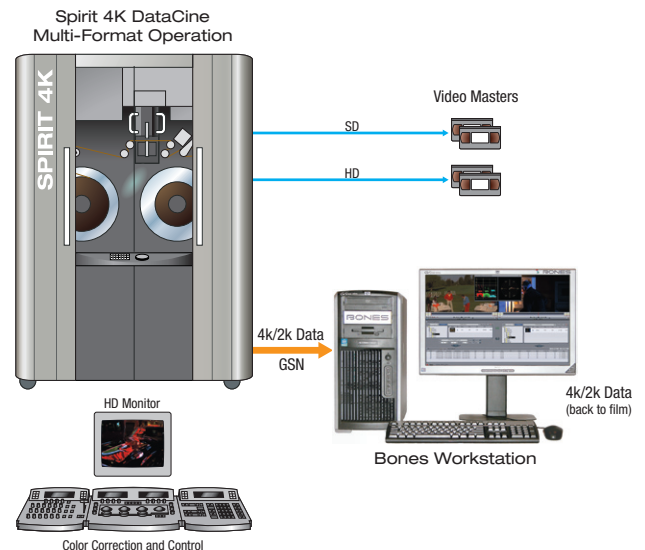
Signal Processing

From the lens gate, the light modulated with the film image goes to a beam splitter where it is divided optically into red, green, and blue components. Each color path has its own CCD sensor which has two CCD line arrays: one with 2,048 photosites for 2k scanning and one with 4,096 photosites for native 4k scanning.

The output from the CCDs is passed through low-noise pre-amplifiers prior to analog-to-digital conversion. From that point, all the digital signal handling and internal processing of the Spirit 4K system takes place at 16 bits up to the output stage for maximum dynamic range and headroom.

The optional internal spatial processor (scaler), which also operates at 16-bit quality, allows you to resize and crop an image as necessary. This processor also provides the precision downsampling you need to derive 2k images from 4k scans.

The Spirit 4K system includes standard and extended primary (RGB) color correction which can be controlled with a Grass Valley GCP. As well, you can control a Spirit 4K system via DaVinci or Pandora controllers. You can also install a Grass Valley 4k/2k film grain reducer and a 4k/2k six-sector color processor in the internal signal path of the Spirit 4K system for complete control over the texture and the color of the image output.



HD and SD Format Processor

For quickly outputting film materials to video, the Spirit 4K DataCine system includes an internal format processor (optional on the Spirit 4K high-performance film scanner and Bones system combination). This processor offers real-time continuous X-Y pan and zoom, anamorphic unsqueeze 2:1, independent X and Y sizing, format presets, digital output blanking, continuous 360° image rotation, horizontal and vertical rhombic effects, as well as a reference store with split-screen capability for SD and HD output signals. You can add these processing functions to the combined Spirit 4K high-performance film scanner and Bones system to provide complete multi-format functionality.

High-Speed GSN Interface

Scanning film at 2k and 4k resolutions requires a high-speed data interface. Grass Valley film-imaging products pioneered the use of the GSN data interface, which is now being adopted by workstation and storage vendors. With practical transfer rates in excess of 500 MB/s, a GSN interface has no problem handling real-time 2k resolution files and can sustain 4k resolution output at rates up to 7.5 fps, depending on the selected packing format and the receiving system's capability.

Delivered through a 12-fiber bundle, the GSN interface of the Spirit 4K system has a range of up to 200 meters and is available on many Grass Valley film-imaging products—allowing you to build a complete digital intermediate center using Spirit 4K high-performance film scanner and Bones system; Spirit 4K DataCine; Spirit 2K DataCine; Spirit 2K high-performance film scanner and Bones system; Specter Virtual DataCine; and Bones Repair, Stabilizer, Scaler, and Color applications.

In addition, the GSN interface comes with an SXGA output that you can calibrate to monitor a high-resolution scan without a dedicated workstation. The Bones workstation provides an interface to external graphics and compositing systems.

Specifications

Mechanical

Dimensions: 1,390 mm (54.73 in.) wide, 1,981 mm (78.00 in.) high, 915 mm (36.03 in.) deep

Weight: ~550 kg (1,212 lbs.)

Electrical

3-phase AC power required: 3X 400V at 50 Hz or 3X 208V at 60 Hz

Power consumption: ~5.7 kVA, typically

Film Size Format

- Full aperture (Super) 35 mm, Academy 35 mm
- 2-perf, 3-perf, 4-perf
- 8-perf/VistaVision (option)
- S16 mm or 16 mm (option)

Film Transport

Direct servo-controlled capstan drive

Fixed Speeds

- 25, 12.5, 6.25 fps at 625 lines/50 Hz
- 29.97, 23.98, 17.98, 11.99, 5.99 fps at 525 lines/59.94 Hz
- 30, 24, 18, 12, 6 fps at HDTV/60 Hz
- 29.97, 23.98, 17.98, 11.99, 5.99 fps at HDTV/59.94 Hz
- 25, 12.5, 6.25 fps at HDTV/50 Hz in forward and reverse

Select-a-Speed

2.00 to 30.00 fps in forward and reverse, up to 7.5 fps in 4k or 4k-to-2k mode (35 mm 4-perf film)

Stop Mode

Frame accurate with full-quality color processing in stop; single frame step forward and reverse with full resolution

Variable Visible Search

With full picture size:

- 16 mm 5 fps – 150 fps (upper limit adjustable to 600 fps)
- 35 mm 4-perf 2 fps – 75 fps (upper-limit adjustable to 240 fps)

Picture Stability

Better than $\pm 0.05\%$ of frame height for 35 mm 4-perf

Framing Adjustment

$\pm 60\%$ of total frame height

Film Capacity

- Up to 1200m (3,937 ft.) on spools
- Up to 900m (2,952 ft.) on cores

Control Interface

Ethernet UDP/IP for all Spirit 4K functions

Light Source

700W xenon lamp

Optical Matching Filters

Print, negative, and intermediate

Focus

Remote manual or automatic mechanical focus control

CCD Pickup Device

Linear CCD sensor with RGB beam splitter switchable between 4k or 2k resolution

Scanned Pixel Size on Film

- ~6.08 μm x 6.08 μm (35 mm 4-perf, 4k mode)
- ~12.17 μm x 12.17 μm (35 mm 4-perf, 2k mode)
- ~3.06 μm x 3.06 μm (16 mm, 4k mode)
- ~6.08 μm x 6.08 μm (16 mm, 2k mode)

White Shading

Automatic correction to $\leq 1\%$ at 100% linear signal, static

Signal/Noise Ratio

Red, green, blue better than 55 dB (unweighted, CRT gamma, 4k or 2k mode)

Masking

Logarithmic (masking)

Aperture Correction

Horizontal and vertical -4 dB to +12 dB at peaking frequency, peak frequency adjustable

Digital Color Correction

- RGB matching
- Automatic Dmin
- PrinterLight (Option)
- RGB primary control (lift, gamma, and gain)
- RGB extended control (coupled black, uncoupled back & white)

Image Resolution (Scaler Option)

- 256 – 4,096 horizontal pixels
- 256 – 3,124 vertical lines (35 mm 4-perf)
- Adjustable and presets
- 4k to 2k conversion

Image Functions

(all active in stop)

(Spirit 4K DataCine or format processor option)

- Continuous X-Y pan and zoom; anamorphic unsqueeze 2:1
- Independent X and Y sizing; digital output blanking
- Horizontal or vertical rhombic effect
- Continuous 360° image rotation

Specifications (cont.)

Contour Correction

(Spirit 4K DataCine or format processor option)

-12 dB to +8 dB, at peaking frequency, peak frequency adjustable

625/525 Functions

(Spirit 4K DataCine or format processor option)

TV standards:

- 625/50, 525/59.94, 2:1 interlace CCIR 601, CCIR 656
- 4:4:4:4 or 4:2:2:4 or 8:4:4 10-bit digital

Display formats: 4:3 and 16:9 full screen and horizontal/vertical letterbox

Zoom range: typical area magnification 0.1X to 16X

625/525 resolution: 35 mm: not more than 3 dB down at 400 lines (5 MHz) in center and corner (film losses not taken into account)

Digital video out: CCIR Link A/B, parallel D-sub 25-pin and serial BNC

HDTV Functions

(Spirit 4K DataCine or format processor option)

TV standards/2:1 interlace:

- 1125 (1035 active)/60 and 59.94 Hz
- 1920x1080/50, 60, and 59.94 Hz

TV standards/progressive:

- 1280x720/60 and 59.94 Hz
- 1920x1080/25, 24, and 23.98 Hz

TV standards/segmented frame:

1920x1080/24 and 23.98 Hz

Display formats: 16:9 full screen and horizontal/vertical letterbox

X-Y zoom: typical area magnification 0.05X to 9X

HDTV resolution: not more than 3 dB down at 24 MHz in center and corner for 35 mm 3-perf/4-perf and 16 mm (film losses not taken into account)

Digital video out:

- CCIR Link A/B, parallel D-sub 50-pin, CCIR TG 11 pinning or serial BNC
- 4:2:2 Y, CB, CR or 4x4 Y, CB, CR, K or R, G, B, K
- 10- or 8-bit per pixel selectable

External reference: BNC input for tri-level sync

Data Output Functions

(Spirit 4K film scanner/Bones, 4K/2K Bones GSN option)

File format: DPX according to SMPTE 268M-1994

Transfer characteristics: TV gamma, linear, logarithmic, user-defined

Transport protocol:

- ST (Schedule Transfer) protocol ANSI NCITS 343-2001
- Image data and file information

GSN (Gigabyte System Network) interface:

- High-performance parallel interface, ANSI NCITS 338-200x (HIPPI-6400-OPT)
- 12 separate full-duplex channels
- Signaling sequence and protocol compatible to ANSI NCITS 323-1998 (HIPPI-6400-PH)

Data output transfer rate:

≥500 MB/s (interface only, excl. system parameter)

Connector: 12 fiber MPO

Transmitting distance: up to 200m

Image monitoring:

- Display characteristics selectable via display look-up tables
- Resolution presets 1280x1024 (SXGA), 1024x768 (XGA), 800x600 (SVGA), 640x480 (VGA)
- Connector mini D-sub 15-pin output

Components and packing:

- 3X 16-bit, RGB
- 3X 10-bit, RGB filled to 32-bit with padding at bits 0 and 1
- 4X 8-bit, RGBA packed to 32-bit, Alpha (A) = space ("0")
- 3X 10-bit, Y-only filled to 32-bit with padding at bits 30 and 31
- 2X 16-bit, Y-only packed to 32-bit

Bones Workstation

The Bones workstation is offered with Bones GSN input but without any disk storage, any other inputs, and any output option. For operation with Bones Transfer at least one disk array is required.

(Spirit 4K film scanner/Bones, 4K/2K Bones GSN option)

Bones Framework:

- Project timeline
- Browsers
- Proxy preview
- Primary color correction
- LUTher node for 3D-LUTs
- Flow graph
- Auto-conformance and editing
- Waveform monitoring and vector scopes
- Markers and notes
- Plug-in API
- Curve editor
- Render farm support
- Streamline operation mode
- Track and timeline flowgraphs

Bones Transfer:

- SD/HD video capture to DPX
- SD/HD video playback
- 2K/4K data capture
- Supports da Vinci/Pandora control
- Local or SAN storage

Bones Mover:

- EDL or keycode list based data and video capture
- Controls scanner and tape drives
- Supports data backup drives DTF, SAIT, etc.
- RS-422 slave playback

Bones System Performance*:

- Data transfer rate min. 290 MB/s
- Related film speed:
 - Up to 24 frames/s at 2K (2048x1556/3X 10-bit RGB filled to 32 bits)
 - Up to 6 frames/s (4096x3124/3X 10-bit RGB filled to 32 bits)

Audio Functions (Optional)**Audio format:**

- COMOPT 35 mm, mono/stereo
- COMOPT 16 mm, mono

Test oscillator:

- 1 kHz and 10 kHz
- -3/0/+4 /+8 dBm switchable to analog out

Frequency response:

- 16 mm: 40 Hz to 8 kHz, -2 dB to +2 dB
- 35 mm: 40 Hz to 12.5 kHz, -2 dB to +2 dB

S/N ratio, weighted:

- 16 mm: better than 52 dB
- 35 mm: better than 60 dB S/N ratio, unweighted RMS:
- 16 mm: better than 58 dB
- 35 mm: better than 65 dB

Audio delay: speed controlled digital audio delay for compensation of the sound to picture offset

Waveform monitoring testpoints: color signals at the output of several processing stages

Display:

- Parade or superimposed waveform
- Vector, image, and mixed mode

Signal format: 1280x1024, SXGA/75 Hz

WFM controls: test point, display, signal format

Connector: Mini D-sub 15-pin analog output to a SXGA monitor (monitor not included)

* Note: The achievable data transfer speed depends on the overall system performance and might be subject to variations. Parameters like the connected storage, the connections between storage and host and the file system are of major impact.

Ordering Information

**SFS 4000 Bones
(000 128 560 810)**

Spirit 4K high-performance film scanner/Bones combination
High-resolution, fast 4k/2k film scanner with Bones workstation

SDC 4000 (000 128 560 110)

Spirit 4K DataCine
High-resolution, fast 4k/2k film scanner with digital HDTV and SDTV interfaces

FH 7082 (000 128 708 210)

Power configuration 240V/400V for three-phase power supply

FH 7081 (000 128 708 110)

Power configuration 115V/208V for three-phase power supply

FH 7052 (000 128 705 210)

Power terminal unit 230V/1-P, 208V/2-P power configuration either for 230V single phase or 208V/two-phase

FD 0709 (000 126 692 900)

Reel drive Set (DIN specs.) c/with spindles of 9 mm diameter (EU)

FD 0708 (000 126 692 800)

Reel drive set (ANSI specs.) c/with spindles of 8 mm diameter (US)

4K S16 LGA (000 128 220 110)

Super 16 mm lens gate assembly for scanning of 16 mm and Super 16 mm film

4K 35 GB (000 128 220 510)

35 mm film gate with Academy projection aperture for format adaption in the FA 35 mm lens gate assembly

4K 16 GB (000 128 220 210)

16 mm film gate for 16 mm film format adaption in the Super 16 mm lens gate assembly

FH 7129 (000 128 712 910)

Audio scanner, Comopt 16/35 mm

S4K-SP1 (000 128 761 110)

Scaler (Spatial Processor) for sizing and format adjustments, converts data scanned in 4k to 2k data

**Bones 4K/2K
(000 128 536 660)**

4K/2K Bones GSN optical data interface, SXGA preview output, Bones Framework, Transfer, Mover software, Bones workstation incl. GSN data input board and display

S4K-FP1 (000 128 738 110)

Format processor (Rack 3) digital SDTV and digital HDTV outputs, rotation, sizing

S4K-VV0 (000 128 761 510)

VistaVision, 35 mm 8-perf film format

S4K-6SC (000 128 760 610)

4k/2k six-sector color processor

SGR-4000 (000 128 760 410)

4k/2k film grain reducer

GCP-EVL (000 128 655 110)

Event list function for GCP

S4K/2K-PL (000 128 761 910)

Spirit 4K/2K PrinterLight option

S4K/2K-AFU (000 128 763 710)

Spirit 4K/2K AutoFocus upgrade

S4K/2K-ADU (000 128 763 810)

Spirit 4K/2K AutoDmin upgrade

Spirit2K/4K-SP

Spirit on-site StartPro commissioning and brief product overview

Spirit2K/4K-Bones-SP

Spirit 2K/4K film scanner/Bones on-site StartPro commissioning

SPiRiT2K/4K-OST

3-day Spirit 2K/4K on-site operational training

Support Services & Training

The Grass Valley Support Services & Training team delivers complete service solutions that enhance your return on Grass Valley products and global systems solutions. Advanced training and proactive support, by reducing down time, keeps your equipment and staff performing at optimum productivity and quality.

Our pre-packaged suite of SupportPRO Services provides support through the whole process:

- StartPRO Commissioning Support
- Factory, On-Site and Web Training Classes
- TechPRO On-Site and Comprehensive Software and Hardware Support
- ServicePRO Comprehensive Software and Hardware Support
- PartsPRO Advanced Exchange Hardware Support
- Critical Spares Kits for Most Products

For specific requests, our worldwide experienced Support Services & Training experts can build and assist you with customized solutions.

For more information contact your authorized Grass Valley representative or visit us online at www.thomsongrassvalley.com/support.

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