DexLogic

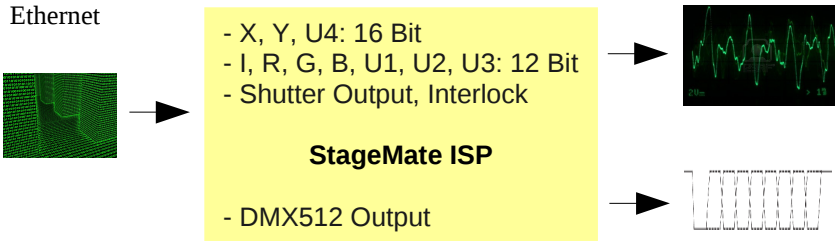
StageMate ISP

Operating Instructions

Congratulations on your purchase of this innovative high-tech tool.

StageMate ISP is a pocket-sized media converter used for the synthesis of analog laser projector signals and DMX512 laser projector control from Ethernet data streams. With its superior set of features, converter resolution and timing, StageMate ISP and its OEM version for projector manufacturers are destined to be the final word in the conversion of Ethernet traffic to laser projector signals.

StageMate ISP receives packetized streams and provides an ILDA Standard Projector (ISP) output. Both subsets are implemented, the analog ISP-DB25 output as well as a DMX512 output for use with ISP-DMX.



The converter implements a preliminary version of IDN, the ILDA Digital Network protocol currently under development. In addition to streams of frames, the converter can process streams of samples – and thus precisely synthesize analog waveforms simultaneously on any of its outputs.

Packetized streaming of samples across a network is the most challenging and the most powerful conversion approach as it allows for the teleportation of arbitrary waveforms – including abstracts – across network infrastructures.

Beyond operating in real time, StageMate ISP's large memory buffers also allow for fixed latencies or delayed streaming under the control of an external clock. This allows the sender to stream data ahead of time when sending non-real time content, thus eliminating network jitter.

With it's advanced frequency synthesizer and hardware FIFOs, StageMate ISP has full control over the output timing with a resolution of 250 nano seconds, up to sample frequencies of 200kHz - independently on all channels. This includes that galvo and color signals (and color signals against each other) can be shifted in time with a resolution of 250 nano seconds.

The converter can be used in conjunction with StageFeed ISP to build a bridge across (or tunnel through) a network to teleport waveforms from one end to another in real time. When directly connecting the converters by an RJ-45 patch cable, the devices act as a digital substitute for an analog ISP cable. This peer mode is always available and requires no configuration. For more complex setups or in conjunction with other senders, the converter supports AutoIP, DHCP and static configuration. It further supports mature mechanisms for enumeration and configuration.

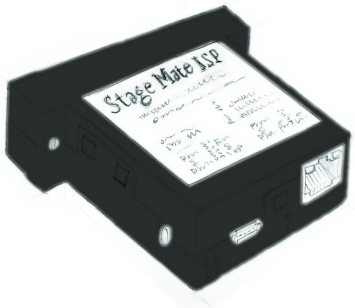
System Features:

- Fully implemented ISP-DB25 and ISP-DMX ports
- IDN (ILDA Digital Network, under development) on 100 MBit Ethernet.
- Zero configuration ILDA ISP cable substitute in conjunction with StageFeed ISP peer mode.
- Sophisticated time line reassembly and tracking algorithm with jitter compensation and automatic latency adaption.
- Flexible frequency synthesizer with a resolution of 250nS, allowing precise playback frequency match and detune used by latency adaption.
- Hardware-assisted sample processing.

Hardware Features:

- 3x16 Bit DAC for X, Y, User 4 signals.
- 7x12 Bit DAC for I, R, G, B, User 1, User 2, User 3 signals.
- 5% overdrive for component tolerance compensation.
- All converters are connected serially and can be driven with individual timings to allow precise time shifts.
- Maximum converter throughput of 250.000 samples per second, full resolution, all channels simultaneously.
- 100 MBit Ethernet MAC/PHY with auto MDI-X.
- Power supply through a Micro-USB socket (PC or mobile charger).
- Hand/Pocket-Size adapter, 60 x 56 x 19 mm.

Connectors and Indicators



1. DMX512 LED (green): signals ISP-DMX output activity.
2. ISP LED (green): signals ISP-DB25 output activity.
3. Micro USB Connector: power supply, 5V/300mA.
4. Power LED (green): signals applied power.
5. RJ45 Connector: 100MBit Ethernet, auto MDI-X / crossover.
6. Bridge LED (blue): indicates an active session, meaning a client has an open connection and thus allocated a session; channels may be active and streaming may be in progress (indicated by the ISP and DMX512 LEDs).
7. Error LED (red): signals boot up, conflicts and internal errors.
8. Push Button: configuration reset, press for under 5 seconds during boot up for user configuration reset (common parameters); for factory reset (all parameters), press for more than 5 seconds.
9. Peer LED (green): indicates a zero-configuration peer link.
10. Link LED (green): standard Ethernet link/activity LED, indicates an active link to another Ethernet PHY.

11. ISP-DMX

2.5mm Jack	DMX512	XLR5	XLR3
Tip	DMX-	2	2
Ring	DMX+	3	3
Sleeve	Ground	1	1

Due to space restrictions of the pocket-sized unit, the DMX512 output uses a 2.5mm jack socket. Optionally available adapters, custom cables or DMX512 and audio adapters 2.5mm -> 3.5mm -> XLR etc. may be used.

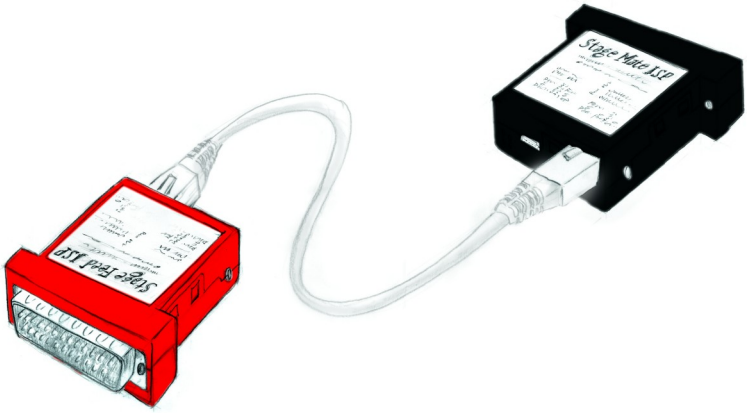
12. ISP-DB25

1	X +	14	X -
2	Y +	15	Y -
3	Intensity +	16	Intensity -
4	Interlock A	17	Interlock B
5	R +	18	R -
6	G +	19	G -
7	B +	20	B -
8	User 1 +	21	User 1 -
9	User 2 +	22	User 2 -
10	User 3 +	23	User 3 -
11	User 4 +	24	User 4 -
12	Projector return (not used)	25	Ground
13	Shutter		

StageMate ISP implements X, Y and User 4 with 16 bit resolution and +/- 10V (plus 5% overdrive) truly differential (both lines +/- 5V with respect to ground). Intensity, R, G, B, User 1, User 2 and User 3 have 12 bit resolution and are 0..5V (plus 5% overdrive) single ended. Their inverted lines are connected to ground pin 25. None of the pins are designed to drive loads (high input impedance is expected, according to the standard). The converter is designed to be connected directly to ISP-DB25 compatible projector inputs.

Peer Mode

Digital ILDA ISP (ILDA Standard Projector) cable substitute

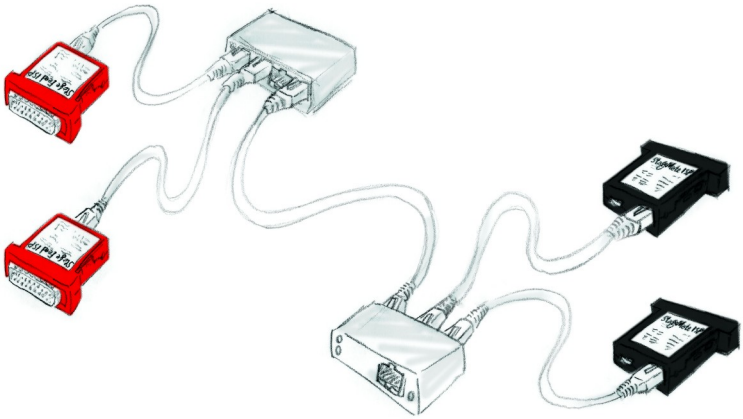


This mode is used as a direct substitute for the ILDA ISP-DB25 and ISP-DMX cables used with most laser projectors. Both converters (StageFeed ISP and StageMate ISP) are connected directly to each other via a standard Ethernet patch cable. Cable length should remain within the 100-meter limit of Cat5/Cat5e cabling.

Auto negotiation detects the peer and does all configurations without user intervention. When connected, the left Peer-LED on both RJ45 sockets light up and StageFeed ISP indicates the bridge with its blue LED.

DB25 signal streaming starts when StageFeed's interlock is closed and DMX512 streaming starts when data is received. StageMate indicates the active session with its blue LED. Both converters indicate streaming with their green ISP and DMX512 LEDs.

Domain mode

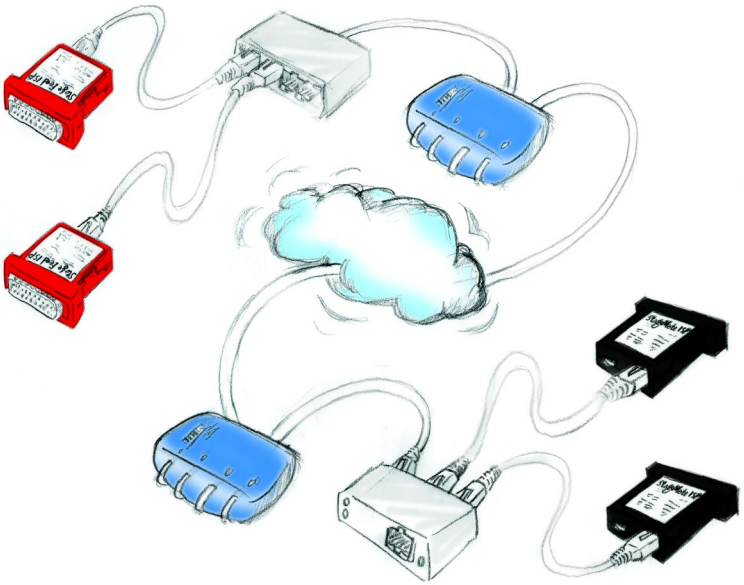


This mode is used to bridge large distances, isolate devices electrically or use existing networking infrastructures. All streams originating from StageFeed ISP converters are combined with an Ethernet switch and transmitted across copper or fiber cables. Then split by a second Ethernet switch and fed into the StageMate ISP converters. The mode can be used to replace ISP-DB25 splitter cables by configuring StageFeed to establish multiple bridges.

StageFeed needs to be paired with one or multiple StageMates. This is done by either connecting the converters directly with a patch cable (Peer Mode) or connecting StageFeed and its StageMates through a separate switch. Once the links are up, StageFeed's button must be pressed with a pin-like tool. The blue bridge-LED will flash and the setup is stored. Pairing information can be noted on the converters backsides. Dividing can be done simply by pressing StageFeed's button while NO Ethernet cable is plugged into its RJ-45 socket.

When connected in the target setup, StageFeed starts building the stored bridges. A solid blue LED indicates that all bridges are up. A flashing blue LED indicates that one ore more link partners could not be found.

Routed mode



This mode can be used to bridge even larger distances or infrastructures. Since there is no common broadcast domain, StageFeed has no way of identifying its partner using the unique UnitID. Setup is more complicated and IP addresses are the only way of finding the configured StageMate.

Either the IP addresses of all StageMates have to be configured statically or DHCP has to guarantee that the assigned IP addresses are same for setup and operation. Apart from this, the setup procedure is the same as used in the domain mode.

Please keep in mind, that StageFeed is transmitting real time content and thus requires reasonable bandwidth. StageMate furthermore needs to reassemble the timing in the magnitude of microseconds in order to copy the signals correctly. Package drops, large network jitter or reception of large amounts of back-to-back Ethernet packets will result in dropouts.

Computer Connections

As with any networking device, the source of the Ethernet data can naturally be a PC, notebook, tablet or smartphone, i.e., practically any device that can send IP packets and run appropriate software. Prerecorded or real time content can be sent in stream mode or frame mode. The converter also features sophisticated mechanisms for scan/enumeration, parameter retrieval and plug and play operation.

Wireless Ethernet

The idea of getting rid of the bulky ISP cables – as well as getting rid of every other cable – is something that appeals to almost everyone, and there is nothing wrong with this. It's brilliantly convenient, and has been proven for years. Others did it, we did it for years - and it just works. The only remarkable thing in this case is that all this is frame-oriented. This means that frames containing laser points or samples (curves and vectors in our case) are transmitted one after another like individual pictures in a movie. One frame is repeated by the converter until the next frame arrives, and so on. This can be done with StageMate ISP as well, using the IDN frame mode; it outperforms other products, since it is much more precise with regard to timing due to packet time-stamps, latency buffers and ahead-of-time streaming.

The situation is different, however, when streaming waveforms. This is an uninterruptible stream of samples that needs to reach its endpoint precisely on time. Extreme caution regarding equipment and setup must be taken, and technicians need to know exactly what they are doing. At the moment further research and improvements need to be carried out on link stability, timeouts and long back-to-back transmissions after wireless link recovery. Fallback in TCP and large increases in latency are subject to ongoing research as well. Generally, as long as good industrial routers (sending at 2.4 and 5 GHz simultaneously, with reliant reassembly) are used with directional radio and the Fresnel zone is taken care of – wireless real time streaming is possible, and has been used with success.

And - in the event packets or the entire link are really lost – plug and play saves the day. StageMate resynchronizes, increases its latency and continues automatically within a fraction of a second.

Additional Features

StageMate ISP is composed of three main parts. The main board with converters, Ethernet phy/magnetics, power and sockets; the processor board with FPGA and memory; and the firmware (StageCore1) with FPGA configuration, software and data files.

Being based on reconfigurable hardware and using documented hardware interfaces, StageMate ISP can run third party configurations and firmware. Alternatively, StageCore1 can be configured for an application and be run on other hardware platforms that implement the required interfaces.

StageCore1 has a modular architecture and is shared among multiple applications. This makes it possible for example, to operate ADC – DSP – DAC inside projectors with analog ISP inputs. StageCore1 will be further developed, extended and improved – and since it defines it's own hardware by configuring an FPGA, be able to perform complex operations in real time, interface to new converters or even implement a digital scanner amplifier.

Planned StageCore1 features (some possibly requiring a separate license)

- WiFi research/improvements.
- DAC output calibration (gain and offset).
- IDN ahead-of-time streaming, buffer/session management
- Time shifts for intensity/color (based on galvo, known as colorshift) and color lines (based on intensity, introduced as color line tweaking).
- Configuration of time shifts in units of microseconds with a resolution of 250 nanoseconds; this keeps the shifts stable for all sample frequencies.
- Laser power linearization, individually for all color lines; uses a polynomial to adjust non-linear laser power response of solid state lasers.
- Geometry processor.
- Color space transformation.
- Safety zones / MPE tracker.

Configuration Reset

StageCore1 implements a two stage configuration reset concept. The first stage (user configuration reset) is used merely to enable the device to run in a plug and play environment. It usually does not really reset values but changes switches, that were used to enable specific user settings. The parameters set by the user usually remain unchanged.

An example for this is the Ethernet configuration. The user may have set up and enabled a static IP address which may not work with the current network environment. To quickly make the device run again, user configuration reset can be used. This simply disables the static address and switches to the default DHCP/AutoIP setting, which either retrieves an address or finds a link-local address.

The second stage is the factory reset. This can be used to set all configuration parameters to their original conditions. Parameters such as bridge routes, device name or device icon are reset as well.

IDN

The ILDA Digital Network (IDN) combines efforts to establish a standard that is a 100% digital equivalent of the ILDA Standard Projector (ISP). Being an equivalent includes that ISP must be convertible to IDN and vice versa (with IDN being a superset). In order to be established as a standard however, many steps need to be taken, including proof of concept and compatibility to existing standards.

Until that point in time, StageCore1 bridges the gap by implementing a preliminary version of IDN that has all features needed for the operation of StageMate ISP. If this protocol were proprietary, that would be the end of the story - but IDN aims to be an open standard. With extensions or changes in IDN, StageCore1 will be updated, and a new image of the firmware can be loaded into flash memory as the user so desires or requires.