

LUTher

Color Space Converter

User Manual



SOFTWARE VERSION 3.0

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Preface

1.1 About This Manual

This LUTher Customer's Manual provides installation, configuration, and operating information for the Grass Valley LUTher Color Space Converter. This manual is designed for technical personnel responsible for installing and maintaining broadcast systems.

1.2 Standard Documentation Set

The standard LUTher documentation set consists of a:

- Planning and Installation part,
- Operating Instructions part and
- Release Notes.

The **Planning and Installation** part contains information about installing, configuring, and maintaining the system.

The **Operating Instructions** part describes operating procedures.

The **Release Notes** contain information about new features and known limitations and work a rounds for a specific software version.

Always check the release notes for your current system software before you begin operating your system.

Regularly Notices

2.1 Certifications and Compliances

2.1.1 FCC Emission Control

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment.

This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications.

Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

Changes or modifications not expressly approved by Grass Valley can affect emission compliance and could void the user's authority to operate this equipment.

2.1.2 Canadian EMC Notice of Compliance

This digital apparatus does not exceed the Class B limits for radio noise emissions from digital apparatus set out in the Radio Interference Regulations of the Canadian Department of Communications.

Le présent appareil numérique n'émet pas de bruits radioélectriques dépassant hors des limites applicables aux appareils numériques de la classe B pour le rack prescrites dans le Règlement sur le brouillage radioélectrique édicté par le ministère des Communications du Canada.

2.1.3 FCC Emission Limits

This device complies with Part 15 of the FCC 47 Rules. Operation is subject to the following two conditions:

1. this device may no cause harmful interference, and
2. this device must accept any interference received, including interference that may cause undesirable operation.

2.1.4 Electromagnetic Compatibility EMC

This product has been evaluated for Electromagnetic Compatibility under the EN 55103-1/2 standards for Emissions and Immunity and meets the requirements for E1/E2 environment.

This product complies with Class B. In a domestic environment this product may cause radio interference in which case the user may be required to take adequate measures.

Category	Standard	Designed/tested for compliance with
EMC	EMC Directive 89/336/EEC via EN 55103-1 and 2	Audio, Video and Entertainment Lightning control for the European Community
	EN 55103-1 standards	Electromagnetic compatibility. Product family standard for audio, video, audio-visual and entertainment lighting control apparatus for professional use. Part 1 Emissions, Environment E1/E2 En 55022: Class B Radiated and Conducted Emissions
	EN 55103-2 standards	Electromagnetic compatibility-- Product family standard for audio, video, audio-visual and entertainment lightning control apparatuses for professional use Part 2 Immunity, Environment E1/E2 EN 61000-4-2: Electrostatic Discharge „ESD“ Immunity EN 61000-4-3: Radiated RF Electromagnetic Field Immunity EN 61000-4-4: Electrical Fast Transient/Burst „EFT“ Immunity EN 61000-4-5: Surge Immunity EN 61000-4-6: Conducted RF Immunity EN 61000-4-11: Voltage Dips, Short Interruptions and Voltage Variations Annex A - Radiated Magnetic Field Immunity Note: This only applies to assemblies sensitive to magnetic fields
	US FCC Class A	CISPR Pub. 22 (1985)
	Canada FCC Industry Canada	
	Australia & New Zealand	AS/NZS 3548

2.1.5 Safety

This product has been evaluated and meets the following Safety Certification Standards:

Category	Standard	Designed/tested for compliance with
Safety	ANSI / UL 1419	Safety Information Technology Equipment, including Electrical Business Equipment.
	CAN/CSA C22.2, No. 60950-1	Safety of Information Technology Equipment, including Electrical Business Equipment
	IEC 60950	Safety of Information Technology Equipment, including Electrical Business Equipment.
	Europe: EN 60950	Safety Information Technology Equipment, including Electrical Business Equipment
	73/23/EEC	Low Voltage Directive

Safety Summary

Read and follow the important safety information below, noting especially those instructions related to risk of fire, electric shock or injury to persons. Additional specific warnings not listed here may be found throughout the manual.

WARNING Any instructions in this manual that require opening the equipment cover or enclosure are for use by qualified service personnel only. To reduce the risk of electric shock, do not perform any servicing other than that contained in the operating instructions unless you are qualified to do so.

3.1 Safety Terms and Symbols

3.1.1 Terms in this Manual

Safety-related statements may appear in this manual in the following form:

WARNING Warning statements identify conditions or practices that may result in personal injury or loss of life.

CAUTION Caution statements identify conditions or practices that may result in damage to equipment or other property, or which may cause equipment crucial to your business environment to become temporarily non-operational.

3.1.2 Terms on the Product

The following terms may appear on the product:

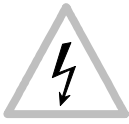
WARNING A personal injury hazard is immediately accessible as you read the marking.

WARNING A personal injury hazard exists but is not immediately accessible as you read the marking.

CAUTION A hazard to property, product, and other equipment is present.

3.1.3 Symbols on the Product

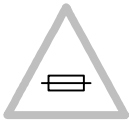
The following symbols may appear on the product:



Indicates that dangerous high voltage is present within the equipment enclosure that may be of sufficient magnitude to constitute a risk of electric shock.



Indicates that user, operator or service technician should refer to product manual(s) for important operating, maintenance, or service instructions.



This is a prompt to note fuse rating when replacing fuse(s). The fuse referenced in the text must be replaced with one having the ratings indicated.



Identifies a protective grounding terminal which must be connected to earth ground prior to making any other equipment connections.



Identifies an external protective grounding terminal which may be connected to earth ground as a supplement to an internal grounding terminal.



Indicates that static sensitive components are present which may be damaged by electrostatic discharge. Use anti-static procedures, equipment and surfaces during servicing.



Safety instruction concerning GSN / Hippi / Fibre Channel Interfaces:

The laser transceivers used in this unit are classified as AEL Class 1(M) (U.S. 21 CFR(J)) and /AEL Class 1(M) per EN 60825-1 (+A11) and are eye safe. They comply with FDA performance standards (21 CFR 1040.10 and 1040.11) for laser products except for deviations pursuant to Laser Notice No. 50, dated July 26, 2001.

3.2 Warnings



The Bones PC workstation and all additional interface boards are designed in conformity with the safety regulations ANSI / UL / EN 60950 and are in a faultless condition when leaving the factory. In order to maintain this condition and to ensure safe operation, the instructions in the manual have to be observed.

The following warning statements identify conditions or practices that can result in personal injury or loss of life.

- **Use only in dry environment** - Do not operate in wet or damp conditions.
- **Use only in non-explosive environment** - Do not operate this product in an explosive atmosphere.
- **Dangerous voltage or current may be present** - Disconnect power and remove battery (if applicable) before removing protective panels, soldering, or replacing components.
- **Do not service alone** - Do not internally service this product unless another person capable of rendering first aid and resuscitation is present.
- **Remove jewelry** - Prior to servicing, remove jewelry such as rings, watches, and other metallic objects.
- **Avoid exposed circuitry** - Do not touch exposed connections, components or circuitry when power is present.
- **Use proper power cord** - Use only the power cord supplied or specified for this product.
- **Operate only with covers and enclosure panels in place** - Do not operate this product when covers or enclosure panels are removed.
- **Use correct fuse** - To reduce the risk of fire, replace only with the same type and rating of fuse. Never use a mended fuse! Do not short-circuit the fuse holder!
- **Servicing** - All servicing instructions are for use by qualified service personnel only. To reduce the risk of electric shock, do not perform any installations other than that contained in the manual unless you are qualified to do so. Refer all servicing to qualified service personnel.

CAUTION Capacitors may still carry a residual charge for approx. 4 minutes after the device was switched off! If, however, working on the opened machine is inevitable, this has only to be done by an expert who is familiar with the dangers involved.

3.3 Cautions



The following caution statements identify conditions or practices that can result in damage to equipment or other property:

- **Provide proper ventilation** - To prevent product overheating, provide equipment ventilation in accordance with installation instructions.
- **Use anti-static procedures** - Static sensitive components are present which may be damaged by electrostatic discharge. Use anti-static procedures, equipment and surfaces during servicing.
- **Do not operate with suspected equipment failure** - If you suspect product damage or equipment failure, have the equipment inspected by qualified service personnel.
- **Ensure mains disconnect** - If mains switch is not provided, the power cord(s) of this equipment provide the means of disconnection. The socket outlet must be installed near the equipment and must be easily accessible. Verify that all mains power is disconnected before installing or removing power supplies and/or options.
- **Use shielded cables** - The EMV regulations are only applicable when correctly shielded cables are used for installation of the equipment. This applies to video cables as well as control cables. Corresponding cables can be obtained from Grass Valley.
- **Route cable properly** - Route power cords and other cables so that they are not likely to be damaged. Properly support heavy cable bundles to avoid connector damage. All external connection cables have to be fed through the Cable feed-through panel, located at the rear of the film scanner, and their cable shields have to be connected to the ground by means of the earthing clamps or the sealing tape.
- **Use correct power supply cords** - Power cords for this equipment, if provided, meet all North American electrical codes. Operation of this equipment at voltages exceeding 130 VAC requires power supply cords which comply with NEMA configurations. International power cords, if provided, have the approval of the country of use.
- **Troubleshoot only to board level** - Circuit boards in this product are densely populated with surface mount technology (SMT) components and application specific integrated circuits (FPGAs). As a result, circuit board repair at the component level is very difficult in the field, if not impossible. For warranty compliance, do not troubleshoot systems beyond the board level.
- **Batteries** - The product contains lithium batteries, which have to be exchanged every five years. Caution! Danger of explosion if battery is incorrectly replaced (interchanged poles). Replace only with the same or equivalent type recommended by the manufacturer. Dispose used batteries according to the manufacturers instructions.

Technical Specification

4.1 Power Supply Frame

Line voltage: 100V-240V AC +/-10% wide range, power factor corrected

Line frequency: 47...63Hz

Power consumption: max. 75W

Leakage current: 0.16 mA typ. at 230VAC

Fuse rating: 2 * 3.15 A T HB (Wickmann 181)

4.2 Environmental Data

Storage temperature: -20 C to +70 C (-4 F to 158 F)

Operating temperature: +5 C to +40 C (41 F to 104 F)

Relative humidity: 95% non-condensing

Electromagnetic compatibility: Environment E1/E2 (according to EN55103-1, -2)

4.3 Video System Data

Applicable Standards:

SDTV: ITU-R BT.601, ITU-R BT.656

HDTV: SMPTE 274 M, SMPTE 292 M

4.4 Mechanical Data

Height 1RU: 44.5 mm (1.75 inch)

Width: 482 mm (19 inch)

Depth: 430 mm (17 inch)

Gross Weight: approx.8 kg (17.64 lbs)

Net Weight: approx.5 kg (11 lbs)

System Overview

5.1 Introduction

With the spreading of Digital Film Applications (DFA) in the postproduction industry problems related to data in different color spaces get apparent. A usual workflow in the postproduction is to transfer film material into the digital domain, do the color grading and complete postproduction there and then record back to film with the finalized images.

As displays used for grading like CRTs and digital projectors have different primaries compared to film material an uncorrected display of the digital data during the color correction sessions leads to a totally different color impression compared to the colors and the look of the images of printed film will give.

To overcome this problem in current post production workflow in most cases a single Look-Up-Table (LUT) for each of the colors is used while in more sophisticated systems a combination of such a LUT with a 3x3 matrix is used. While the LUT serves to correct for gray levels and luminance values the matrix has the ability to transfer the primaries of the color spaces onto each other.

Due to the non-linearity of the film printing and development process in conjunction with the different sizes of the color spaces of film and display even a combination of LUT and matrix is not able to correct the color in large regions of the color space. From his experience the colorist still has to extrapolate the colors of the final print film from what he sees on the grading display.

The target of this new product (Color Space Converter LUTher) is to implement a three dimensional LUT resident in hardware to overcome this problem. It gives the user full flexibility for a complete color space conversion with an easy to use interface for operation. The small hardware box will have video SD/HD data interface for color grading on CRTs, digital projectors and computer monitors. It can be attached to the output used for monitoring of any color correction device without using any of the resources of that unit.

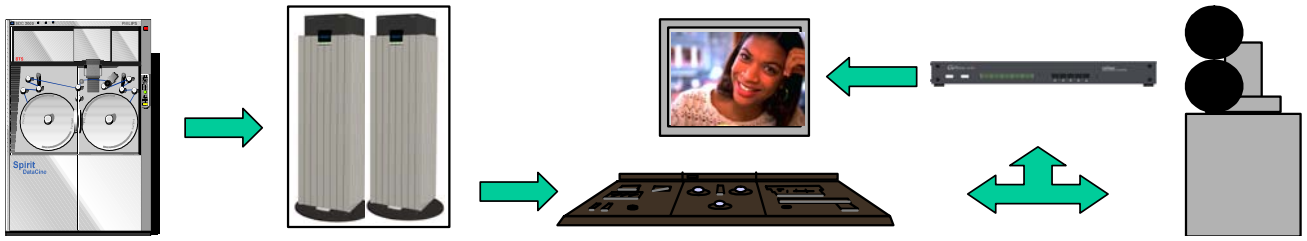


Figure 1 Overview

5.2 Application

The Color Space Converter LUTher is intended to be used with every major display monitor through the post production process. This gives the user the possibility to individually adjust each display's color characteristics to match the look of the final product to printed film.

Full Color Space Conversion:

- Linear (only visually equal colors are mapped / hard clip else)
- Convert (colors are mapped according an algorithm)

Color Gamut Conversion:

- Film <-> CRT
- Film <-> Digital Projector
- Digital Projector <-> CRT
- Correct for permanent copy process errors of Lab
- Color Correction with translation matrices

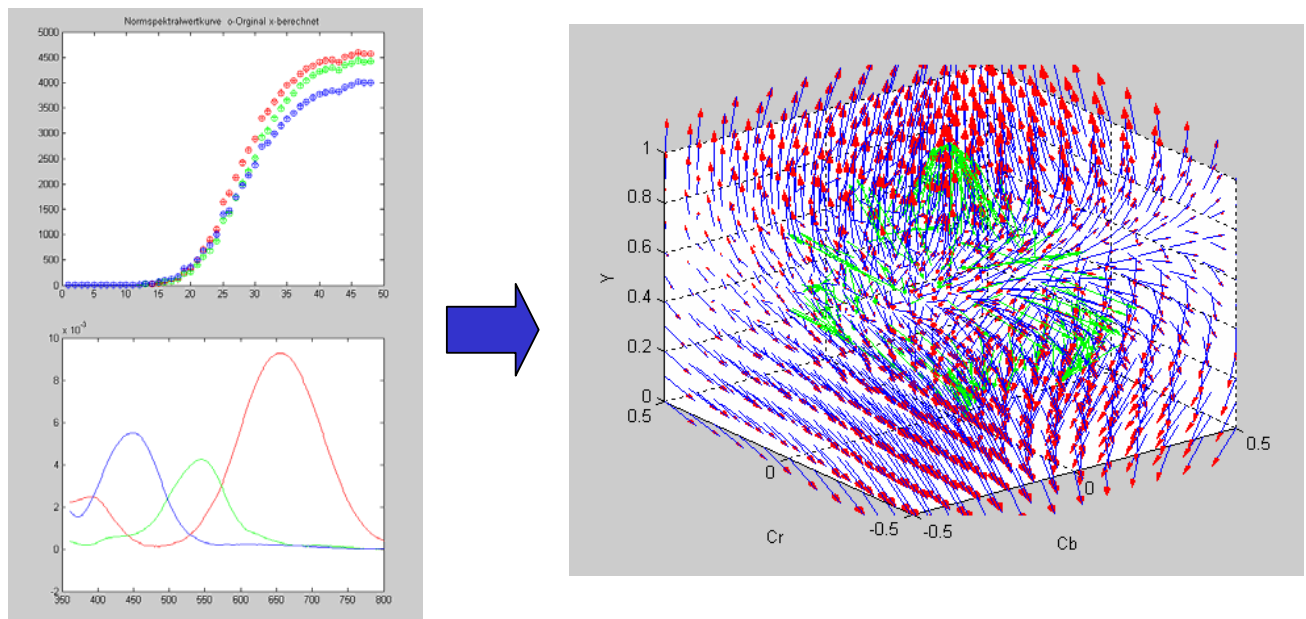


Figure 2 Visualization of 3D-LUT

5.3 Performance of Product

The Color Space Converter LUTher is a 1 RU box which is attached between a data source and the input of a display device. Usually it is configured once and holds this setup during power up cycles. It is equipped with a LAN and a USB interface which makes it easy for any operator to either load his individual setup via LAN or use a USB memory stick to match the display according to his individual needs. The internal controller holds a PC and therefore there is a power up boot time of approximately 2 minutes.

5.4 Features

5.4.1 Video Interfaces

The standard version of Color Space Converter LUTher is equipped with a SD video interface compliant to SMPTE 259M / ITU-R BT.656 and an HD video interface compliant to SMPTE 292M.

The interfaces are running 4:2:2 Y, Cr, Cb signals with 10 bit resolution as well as 4:4:4 Y, Cr, Cb.

5.4.2 Local Control and Display

Several LUTs can be stored on the hard disk of the Color Space Converter LUTher. These can be selected via a knob on the front side of the unit. The selected LUT can be identified by its name on a simple local display sitting on the front side as well.

5.4.3 1:1 Mode

There is a unity mode available where the signal path through Color Space Converter LUTher is completely transparent.

5.4.4 Loadable 3D LUTs

The main purpose of Color Space Converter LUTher is to convert color spaces between processing units and display devices. There is the ability to load complete 3D LUTs into the unit. These LUTs will be calculated on a separate PC and downloaded into Color Space Converter LUTher via LAN or via a USB stick.

The resolution of the 3D LUT can be up to a resolution of 129x129x129 resulting in a complete storage volume of 8 MBytes.

5.4.5 Remote Interface

The remote interface between Color Space Converter LUTher and the controlling computer is a standard LAN computer interface with a maximum transfer capacity of 100 MBit per second.

5.4.6 Color Space Converter LUTher Ordering Information

Type / order no	Description
LUTher 0 128 470 010	Color Space Converter LUTher, incl. mains cable Euro 2.5 m & mains cable US 2.5 m

5.5 LUTher Frame

The LUTher frame houses the system electronics in a very compact design. A built-in fan system allows cooling of the frame. The connectors are located at the rear of the frame.

The frame contains the following modules:

- Color Space Converter Board FY 4710, incl. Computer Module, SDRAM Module 128Mbyte, 2.5" Hard Disk Drive, Flat Cable FH 4705, DVI Board (future option)
- Power Supply Unit ZWS 75
- 2 x Fan Unit RC 3783
- Cable Set FH 4701

The figure below shows the frame with opened housing.

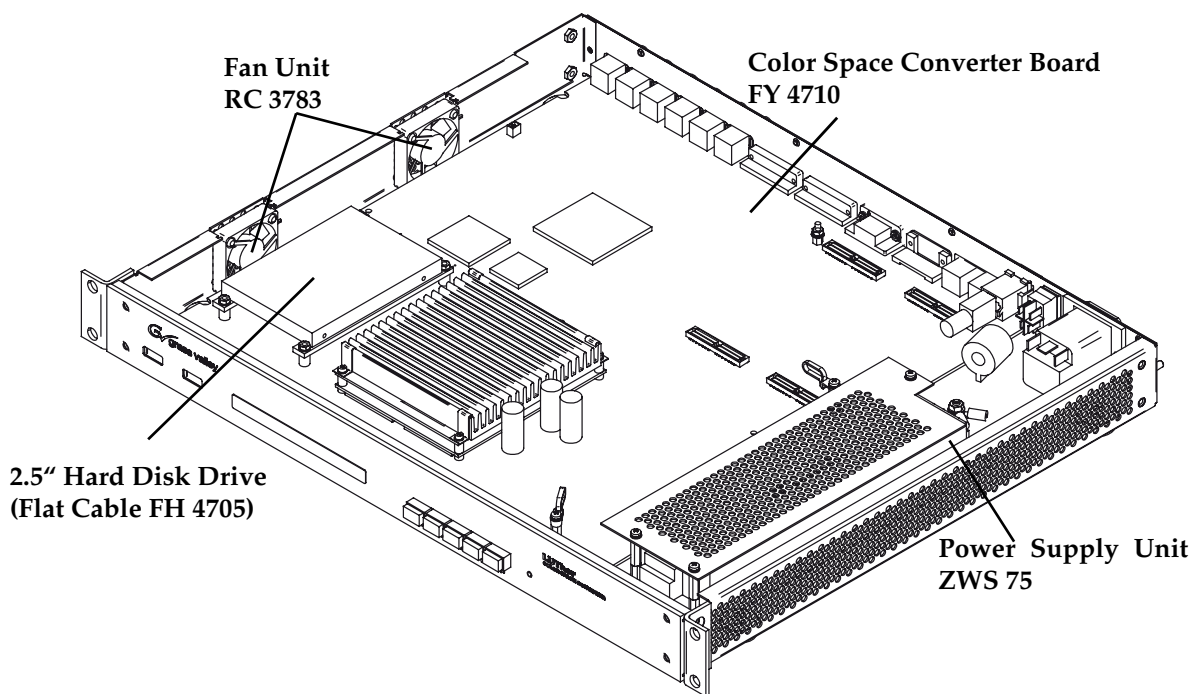


Figure 3 LUTher Frame With Opened Housing

5.6 Functional Overview

5.6.1 Video Signal Flow

LUTher accepts the following video input signals:

- serial digital **4:2:2** component **SD** video
- serial digital **4:4:4** component **SD** video
- serial digital **4:2:2** component **HD** video
- serial digital **4:4:4** component **HD** video

If **4:2:2** component video signals have to be processed, the input connector **J29-Input Link A** has to be used.

If **4:4:4** component video signals have to be processed, the input connector **J30-Input Link B** has to be used in addition to J29.

SD or **HD** video processing has to be **selected** by the user **via the User Panel**.

LUTher has **two equivalent outputs**, the connector pair **J34/J31** and the connector pair **J32/J33**.

An **4:2:2** component video output signal is available at the connectors: **J34-Output Link A** and **J32-Output Link A**.

An **4:4:4** component video output signal is available at the connector pairs: **J34-Output Link A / J31-Output Link B**
and
J32-Output Link A / J33-Output Link B.

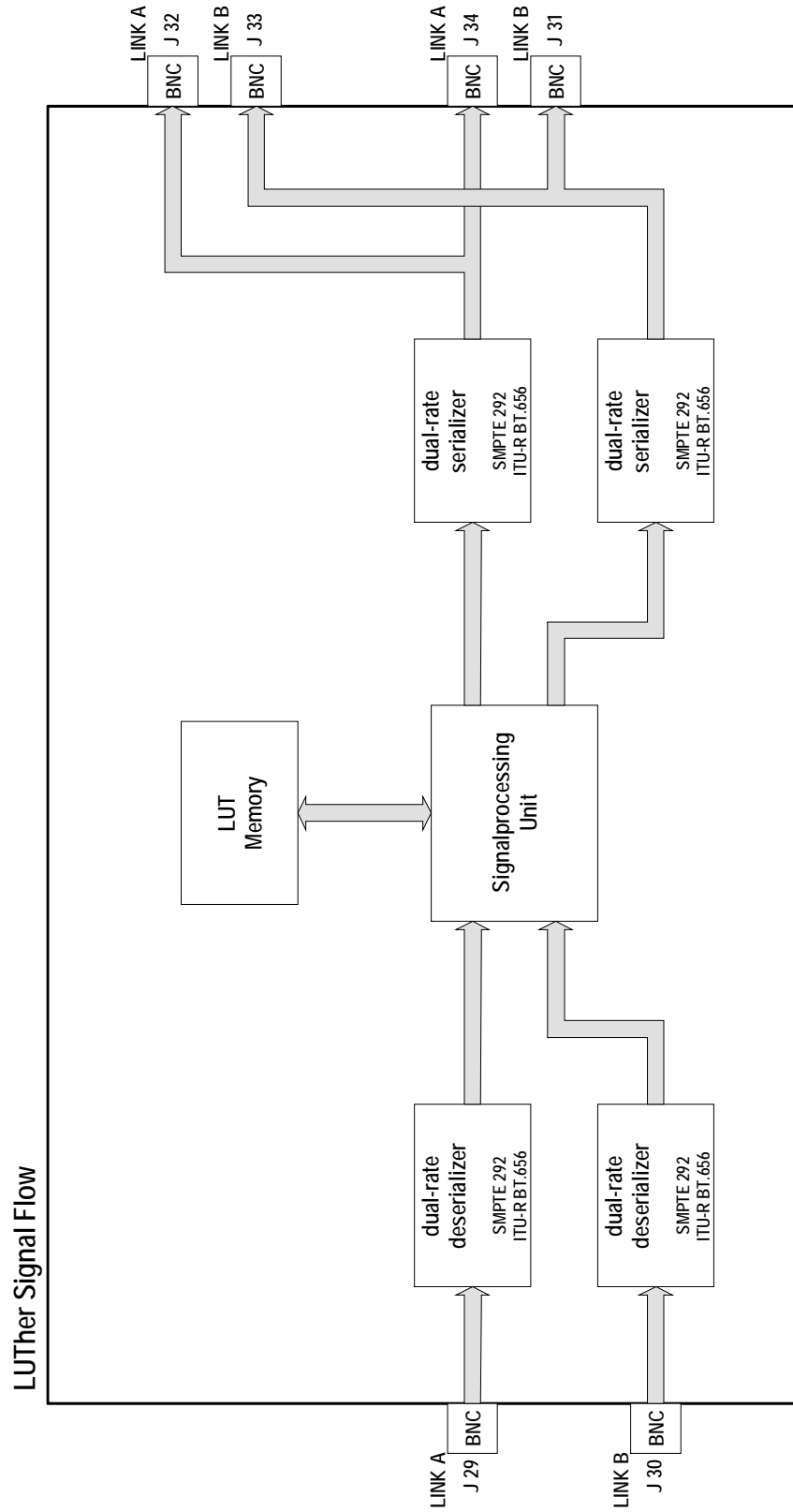


Figure 4 LUTher signal flow diagram

Installation

This section describes the installation and setup of the Color Space Converter LUTher hardware.

6.1 Pre-Installation Procedures

Before you physically install the Color Space Converter LUTher, familiarize yourself with the tools required, physical specifications, and safety and power requirements covered in this section.

6.1.1 System Survey

Check all parts received against the packing list enclosed with your shipment, and examine the equipment for any shipping damage. Immediately report any missing or damaged items to the carrier and to your Grass Valley service representative.

6.1.2 Line Voltage

The Color Space Converter LUTher utilizes a wide-range power supply that accommodates 100 - 240V. No switch settings are required, nor are any possible.

6.1.3 Safety Requirements

To prevent injury or equipment damage, read, understand, and follow all installation safety precautions.

WARNING The Color Space Converter LUTher frame weights approximately 5 kg (11 lbs). Provide appropriate equipment to support the frame during installation.

WARNING Electrical potential is still applied to some internal components even when power to the frame is off. To prevent electrical shock when working on this equipment, disconnect the AC line cords from the AC source before working on any internal components. Residual voltage may be present immediately after unplugging the system; wait thirty seconds to allow capacitors to discharge before working on the system.

CAUTION To avoid static damage to sensitive electronic devices, protect the Color Space Converter LUTher from static discharge. Avoid handling frame modules in a high static environment. Use a grounding strap when handling modules, and touch the frame before you remove any modules.

6.1.4 Installation Tasks

After completing the Pre-Installation procedures, the recommended installation tasks given in this section are:

1. Unpack the equipment,
2. Install the Color Space Converter LUTher frame,
3. Connect cables to signal inputs and outputs, and
4. Connect the power cable.

6.2 Mounting the LUTher Frame

6.2.1 LUTher Frame Measurements

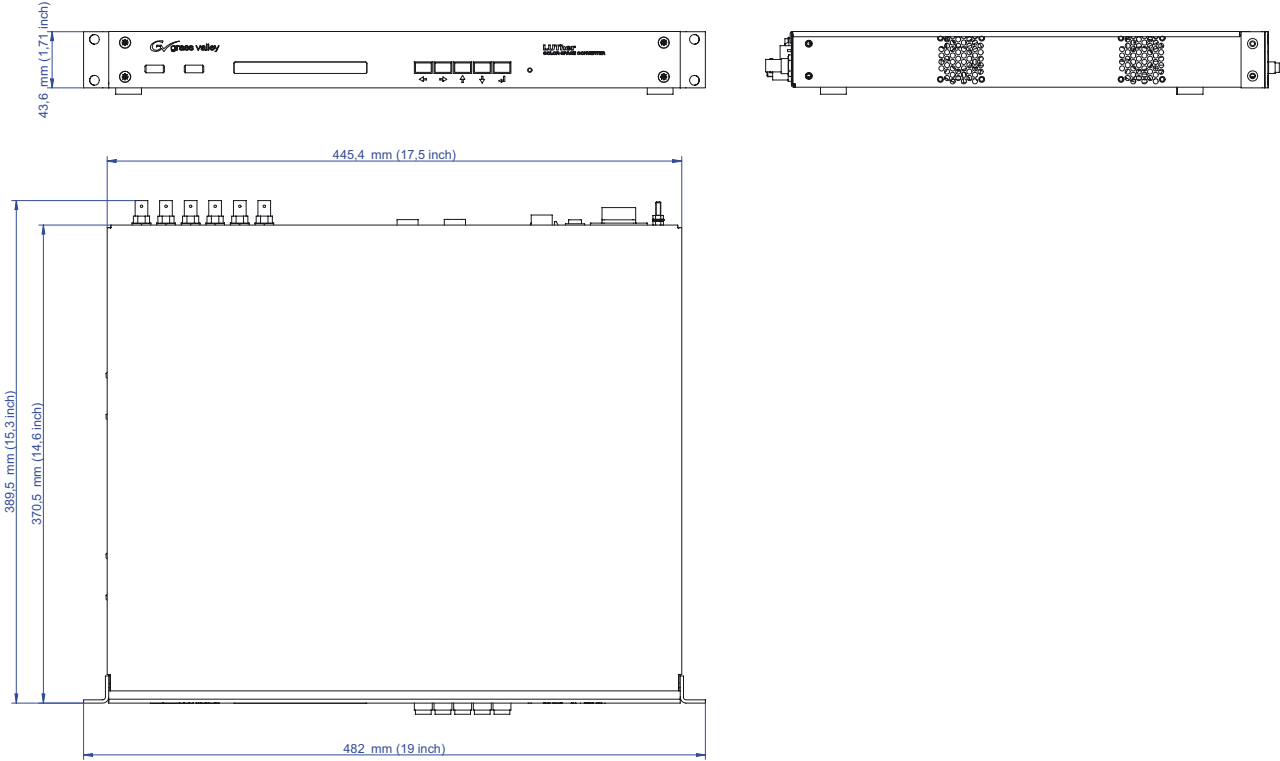


Figure 5 LUTher frame dimensions

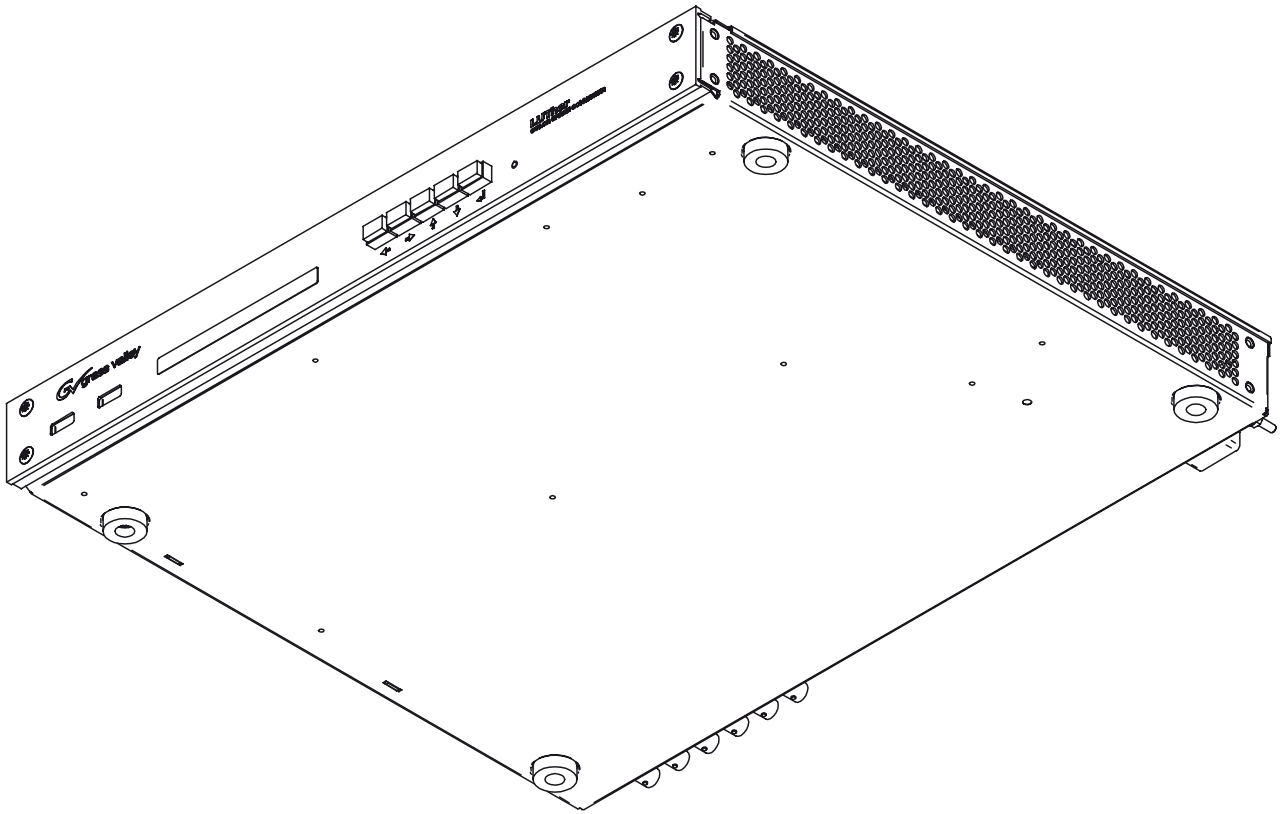


Figure 6 LUTher With Mounted Housing Feet

6.2.2 General Rack Mounting Instructions

- The maximum ambient temperature for this unit is 40° C (104 F).
- Installing the unit in a closed or multi-unit rack assembly, together with other units could increase the maximum ambient for this unit.
- If the unit is installed in a rack, no ventilation openings should be blocked or otherwise covered. Ensure a sufficient amount of airflow. Airflow through the LUTher is from the left side of the frame to the right side of the frame.
- Mounting of the unit in the rack should be such that a hazardous condition is not achieved due to uneven mechanical loading.
- When connecting the unit to the supply circuit be sure that the supply circuit of the rack is not overloaded. For ratings see chapter Technical Specifications.
- The unit must be grounded to a good earth ground using a wire as specified by the local electrical code. This wire is attached to the protective earth connector on the rear.
- When connecting the unit in a closed or multi-unit rack assembly together with other units be sure that the summation of the touch (leakage) currents for each power supply circuit is not higher than 3.5 mA. In this case the rack must be permanently connected with an earth terminal. Earth connection is essential before connecting supply voltage! For details see chapter Technical Specifications.

The LUTher frame has to be mounted in a rack using the delivered screws and accessories.

Note Remove the four housing feet before rack mounting.
Insert and fasten the four screws again to close the holes.

6.2.3 Rack Mounting Procedure

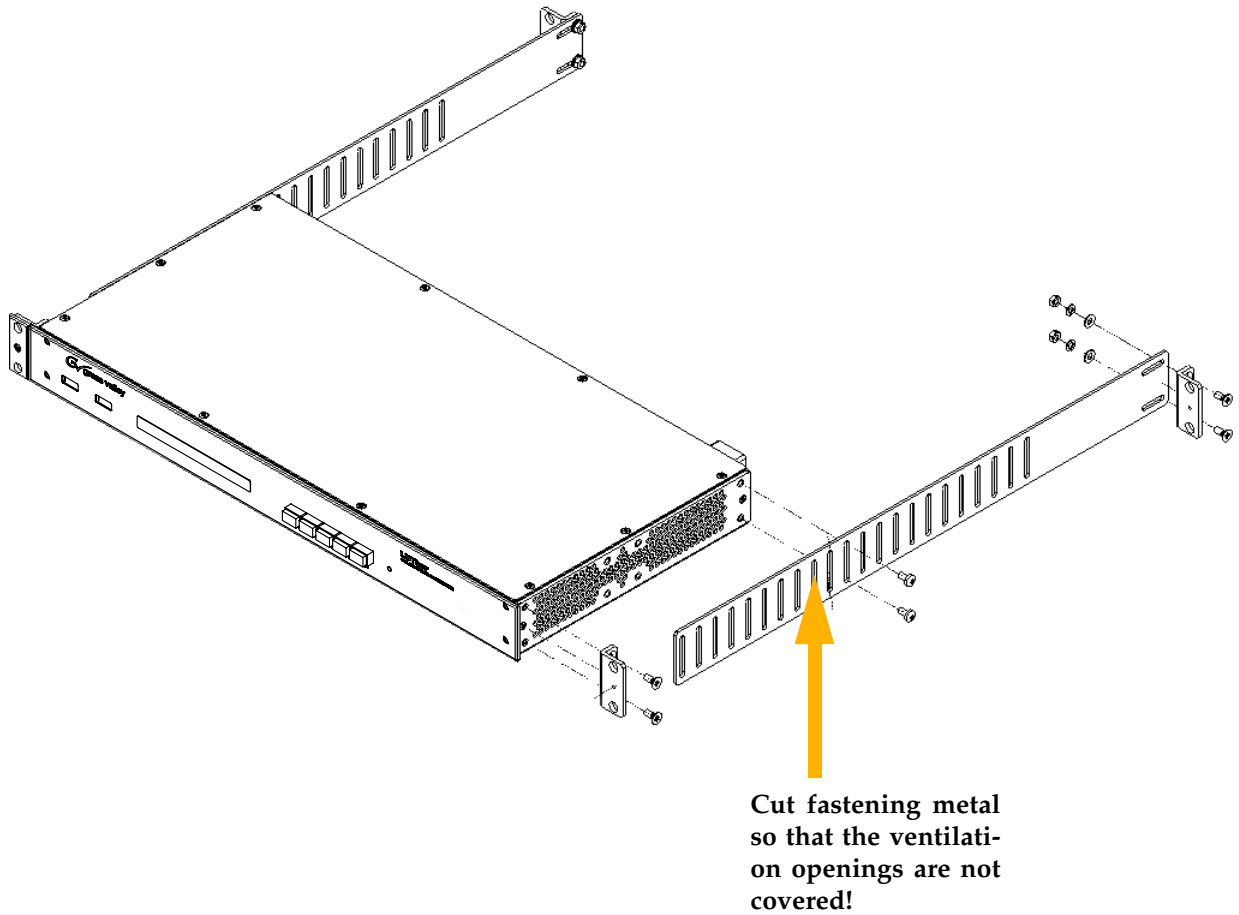


Figure 7 Luther frame Rack Mounting

- Fix the four rack angles of the LUTher frame to the rack using eight screws.

WARNING It is not allowed to fix the LUTher frame using the rack angles only!

6.3 LUTher Connectors

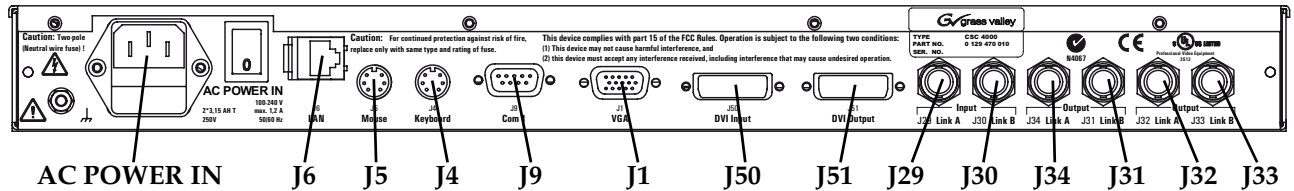


Figure 8 LUTher Connectors (Rear View)

The rear of LUTher provides the power and system control connectors for the system:

Jack	Designation	Note
	AC POWER IN	Mains connector (IEC-320, CEE-22) for power supply. Operating Voltage: 100V-240V AC +/- 10% wide range CAUTION! Double-pole or neutral fusing. After operating of the protective device, parts of the equipment that remain under voltage might represent a hazard during servicing. CAUTION! For continued protection against risk of fire, replace only with same type and rating of fuse! 2x 3.15A T HB
	AC POWER IN	Power switch.
	M4 threaded pin	Screw terminal for additional unit earthing.
J6	LAN	RJ45 connector for connection to LUTher.
J5, J4	P/S 2	Possibility to connect a P/S 2 mouse (J5) or keyboard (J6).
J9	COM1/RS 232	RS232 interface for connecting a diagnosis computer.
J1	VGA	VGA interface for connecting a VGA Monitor.
J50	DVI Input (future option)	DVI input (Digital Visual Interface) for connecting devices with a DVI output.
J51	DVI Output (future option)	DVI output (Digital Visual Interface) for connecting a Monitor with a DVI input.
J29, J30	Input Link A, Input Link B	BNC / Serial digital 4:2:2 / 4:4:4 component SD / HD video inputs.
J34, J31	Output Link A, Output Link B	BNC / Serial digital 4:2:2 / 4:4:4 component SD / HD video inputs.
J32, J33	Output Link A, Output Link B	BNC / Serial digital 4:2:2 / 4:4:4 component SD / HD video inputs.

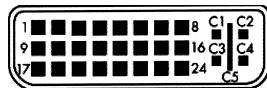
Additional connectors at the front panel.
These connectors are operator accessible!

Jack	Designation	Note
	USB (left, right)	Connectors for USB devices, e.g. Memory Stick.

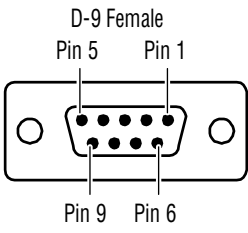
6.4 Pin Assignments

6.4.1 DVI Input / Output (Future Option)

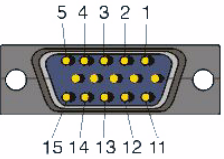
Socket	Pin	Signal
DVI-I Female (Integrated, analog + digital)	C1	Analog: Red
	C2	Analog: Green
	C3	Analog: Blue
	C4	Analog: H-Sync
	C5	Analog: Ground
	1	TDMS Data 2-
	2	TDMS Data 2+
	3	Shielding Data 2, 4
	4	TDMS Data 4-
	5	TDMS Data 4+
	6	DDC Clock
	7	DDC Data
	8	Analog: V-Sync
	9	TDMS Data 1-
	10	TDMS Data 1+
	11	Shielding Data 1, 3
	12	TDMS Data 3-
	13	TDMS Data 3+
	14	+5 Volt
	15	Ground for +5 Volt
	16	Hot Plug Detect
	17	TDMS Data 0-
	18	TDMS Data 0+
	19	Shielding Data 0, 5
20	TDMS Data 5-	
21	TDMS Data 5+	
22	Shielding TDMS Clock	
23	TDMS Clock+	
24	TDMS Clock-	



6.4.2 COM1 / RS 232

Socket	Pin	Signal
 <p>D-9 Female Pin 5 Pin 1 Pin 9 Pin 6</p>	1	Chassis Ground
	2	Transmit Data
	3	Receive Data
	4	Not used
	5	Signal Ground
	6	Not used
	7	Clear to Send
	8	Request to Send
	9	Not used

6.4.3 VGA (Monitor Connector)

Socket	Pin	Signal
 <p>5 4 3 2 1 6 15 14 13 12 11</p>	1	Signal: Red
	2	Signal: Green
	3	Signal: Blue
	4	ID Bit 2
	5	-
	6	Ground: Red
	7	Ground: Green
	8	Ground: Blue
	9	-
	10	Ground: Sync.
	11	ID Bit 0
	12	ID Bit 1 / DCC SDA Data
	13	Horizontal Sync
	14	Vertical Sync
	15	ID Bit 3 / DCC SCL Clock

6.5 Cabling and Control

6.5.1 Control Cabling

A simple LUTher system, containing Control Keys, does not require connection to an external Ethernet Local Area Network (LAN).

The LUTher system uses Ethernet, serial, parallel, and USB connections.

6.5.1.1 Mouse and Keyboard Connection

A standard PS/2 Mouse and Keyboard can be installed to the rear of LUTher if desired (see [Figure 8](#)). Be sure to power down before installing either the mouse or keyboard.

6.5.1.2 LAN Requirements

A simple LUTher system does not require an external Ethernet Local Area Network (LAN).

A LUTher system requires a LAN when external network access to a file system is desired.

Note All Ethernet components must be supplied by the customer.

Ethernet Specifications	
Type	10Base-T and 100Base-T compatible. Category 5 cable, 8 conductor twisted pair. The system will work at 10Base-T with reduced performance. 100Base-T components are highly recommended.
Speed	Dual: 10 and 100Mb

6.5.1.3 Factory Settings

The default factory setting for the IP address is

- 192.168.20.170

The Setup menu allows to change the IP address.

Operating

7.1 Front Elements

The following figure shows the front panel with its control elements, USB connectors and the display:



Figure 9 LUTher Front Elements

7.2 Control Buttons

LUTher can be controlled with five buttons at the front panel (see Figure 9). These buttons are:

- ← left button
- right button
- ↑ up button
- ↓ down button
- ↵ enter button

Additionally two USB connectors and one RJ45 connector at the rear panel can be used to control LUTher.

7.3 Display

The display at the front panel consists of 20 characters. The display is used to show LUTher's current status and offers a menu while controlling LUTher.

After about two minutes after power up one can read **Init** followed by a **Loading Firmware** at the display. After the firmware is loaded (approximately 10 seconds) a LUT is loaded. This is also displayed with a similar progress. Afterwards LUTher becomes idle.

In idle mode the last loaded LUT and the video standard is displayed.

7.4 Menu

This section describes how the LUTher can be controlled with the local control buttons.

If LUTher is in idle mode it is possible to press one of the control buttons to activate the main menu. If the main menu is activated use the left and the right button to select a different menu item. The up and down buttons can be used to choose a different entry within the selected menu item. The enter button has to be pressed to apply the selection. After ten seconds without pressing any button LUTher becomes idle again.

The main menu items differ depends on, if the limited control menu is activated (see [Section 7.4.3](#)) and whether an USB stick is connected or not. Almost all functions can be controlled remotely with the 3D LUT Designer. The 3D LUT Designer is a software tool running on a Linux PC.

The following four sections describe these different menus in detail: [Section 7.4.1](#) describe all available menu items if no USB stick is connected. This menu changes as soon as a USB stick is connected to the LUTher. The menu with a USB stick is described in [Section 7.4.2](#). It is possible to restrict the available menu items as described in [Section 7.4.3](#). An overview of all menu items is given in the [Section 7.4.4](#).

See [Section 7.6](#) to read about working with a USB stick.

7.4.1 Menu Without a USB Stick

The following main menu items are selectable when no USB stick is connected and if one has full control of the menu:

- **Sel:** to select an existing 3DLUT and to activate it
- **Printer Light:** to switch on or off the Printer Light values
- **Viper Delog:** to switch on or off the Viper Delog function
- **Del:** to delete an existing 3D LUT
- **Video Format:** to select the video format
- **Software:** to display or to modify system settings
- **SW Reset:** to reset the video processing

The Printer Light menu item has the sub menu item:

- **Printer Light Setting:** to modify the Printer Light offset values

Press the Enter button within the Printer Light menu to go to the Printer Light setting menu.

The Software menu item contains the sub menu items:

- **Software:** to display the software version
- **Firmware:** to display the firmware version
- **CPLD:** to display the CPLD version
- **HW index:** to display the hardware index
- **EEProm version:** to display the EEPROM version
- **IP address:** to display the IP address
- **Set IP address:** to modify the IP address
- **Netmask:** to display the IP netmask
- **Set Netmask:** to modify the IP netmask
- **HostID:** to display the Host ID
- **Interpolation:** to display the interpolation type
- **Select Interpolation:** to change the interpolation type
- **Proc.Range:** to display the processing range
- **Select Proc.Range:** to change the processing range
- **Service:** to display the service status
- **Password:** to activate or deactivate service functions

Some of these Software menu items are only available if the service functions are activated.

If the **Sel** menu item is chosen one can select the desired LUT with the up and down button. Once the desired LUT is displayed one can press the enter button to activate the LUT.

Printer Light

Within the Printer Light menu it is possible to activate or to deactivate the Printer Light Offset simulation using the Up and Down buttons. The Printer Light simulation will take in effect after processing the 3D LUT. If the Printer Light simulation is activated one can go to the Printer Light Setting menu by pressing the Enter button. Here the initial message "M R25 G25 B25" is displayed and *M* is blinking, which is a abbreviation for master (or common gang control). Within this menu it is possible to increment and decrement the individual R,G,B values or to use the common gang control. The initial setting is 25, 25, 25 and the range for the three channels is from 0 up to 50. The resulting image is adjusted in steps of 12.5 code values independently in R, G and B. Changes to the R,G,B values influence immediately the output image of LUTher. The current selected channel (M, R, G, B), which is blinking, can be changed with the Left and Right button. Using the Up and Down button will then either increment or decrement the select channel. Pressing the Enter button will leave this menu item.

All Printer Light settings will be saved permanently until one changes the settings again. This means that if one for instance activates the Printer Light Offset simulation and chooses R20, G30, B26 as Printer Light setting values than LUTher will restart after a reboot with these settings.

Viper Delog

Within the Viper Delog menu it is possible to activate or to deactivate the Viper Delog simulation using the Up and Down buttons. The Enter button has no meaning within this menu. The Viper Delog simulation will take in effect before processing the 3D LUT. There are some initial settings that are used to compute the Viper Delog function. These settings cannot be changed with the local control menu but only with the 3D LUT Designer. The settings will be saved permanently to the LUTher until one changes the settings again.

If the **Del** menu item is chosen it is possible to select a LUT which shall be permanently removed from LUTher. Press the enter button to apply the selection. A security question follows where one has to confirm that the selected LUT shall be removed.

The **Video Format** menu item offers the possibility to select the outgoing video format between 422 and 444 and between RGB and YCbCr. Also the incoming video format has to be determined. One has to use the up and down buttons to choose and to press the enter button to apply the selected video format. The current video format is displayed in idle mode.

It is automatically detected whether the incoming video standard is SD or HD. The video standard of the outgoing signal is the same as the incoming video standard.

One of the following video formats can be chosen in the "Video" menu:

Video Format in „Video“ menu	Incoming video signal		Outgoing video signal	
422-YCbCr 422-Y CbCr	4:2:2	YCbCr	4:2:2	YCbCr
422-YCbCr 444-Y CbCr	4:2:2	YCbCr	4:4:4	YCbCr
422-YCbCr RGB	4:2:2	YCbCr	4:4:4	RGB
444-YCbCr 422-Y CbCr	4:4:4	YCbCr	4:2:2	YCbCr
444-YCbCr 444-Y CbCr	4:4:4	YCbCr	4:4:4	YCbCr
444-YCbCr RGB	4:4:4	YCbCr	4:4:4	RGB
RGB 422-Y CbCr	4:4:4	RGB	4:2:2	YCbCr
RGB 444-Y CbCr	4:4:4	RGB	4:4:4	YCbCr
RGB RGB	4:4:4	RGB	4:4:4	RGB

The **Software** menu item is useful to get information about the current system settings. The currently installed control software version is displayed. Other data as for instance the firmware version is displayed within its sub menus as described below.

The **SW Reset** menu item can be used to reset the video processing.

With the up and down button starting in the **Software** menu one can also see the **Firmware** version, the **CPLD** version, the **hardware index** and the **EEProm** version. This is only useful for authorized personnel.

Also the service status is displayed. Usually the service is inactivated (**Service: no**) which means for instance that one cannot change the IP address. See [Section 8.3](#) mode how to activate the service functions. See also [Section 7.4.4](#) to get a list of all service functions.

The **IP address** can also be displayed within the submenu of the Software menu. If the service functions are activated then it is possible to change the IP address by pressing the Enter button when it is displayed. Now one can enter a new IP address with the left and right buttons to navigate to all digits and with the up and down buttons to change a digit. Apply the new IP address with the enter button. Once applied LUTher gets rebooted.

The **IP netmask** can also be displayed as one of the submenu items of the Software menu. It can be changed only if the service functions are activated. Press the Enter button when it is displayed and enter a new IP netmask with the left and right buttons to navigate to all digits and with the up and down buttons to change a digit. Apply the new IP netmask with the enter button. Once applied LUTher gets restarted.

The **Host ID** is only displayed when the service functions are activated. Otherwise this option has no further meaning.

The **Interpolation** menu is also a service function. It displays the current used 3D LUT interpolation type, which is either Trilinear or Tetrahedral. Pressing the Enter button will go to the **Select Interpolation** menu where one get use the Up and Down buttons to choose the desired interpolation type. Press the Enter button to confirm the new interpolation type.

The **Proc.Range** menu displays the currently used processing range. All available options are **HD_TV**, **SD_TV**, **HD_Graphics** and **SD_Graphics**. The **HD_TV** and **SD_TV** processing ranges are transparent. Here the incoming YCbCr video signal (64-940 = legal range) is mapped to the legal range (from 64 to 940) before it is being processed and at the output it is mapped back to the legal range. **HD_TV** is the default processing range. The processing range **HD_Graphics** means that the incoming YCbCr video signal (legal range) is mapped to the complete data range from 0 to 1023 (full range) before it is being processed e.g. with the 3D LUT. At the output it is mapped back to the legal range (64 - 940). The **SD_Graphics** processing range also maps the incoming YCbCr video signal to the complete data range from 0 to 1023 with the difference that here optimal parameters for a SD signal are used. When one presses the Enter button the menu changes to the **Select Proc.Range** menu where one can use the Up and Down buttons to choose the desired processing range. Press the Enter button to confirm the new processing range. A new setting is saved permanently until one changes this setting again.

The following two figures on the next pages show all available menu items when no USB stick is connect to the LUTer. The first figure shows all menu items if the service functions are not activated and the second figure shows also all additional menu items in the Software menu when the service functions are activated.

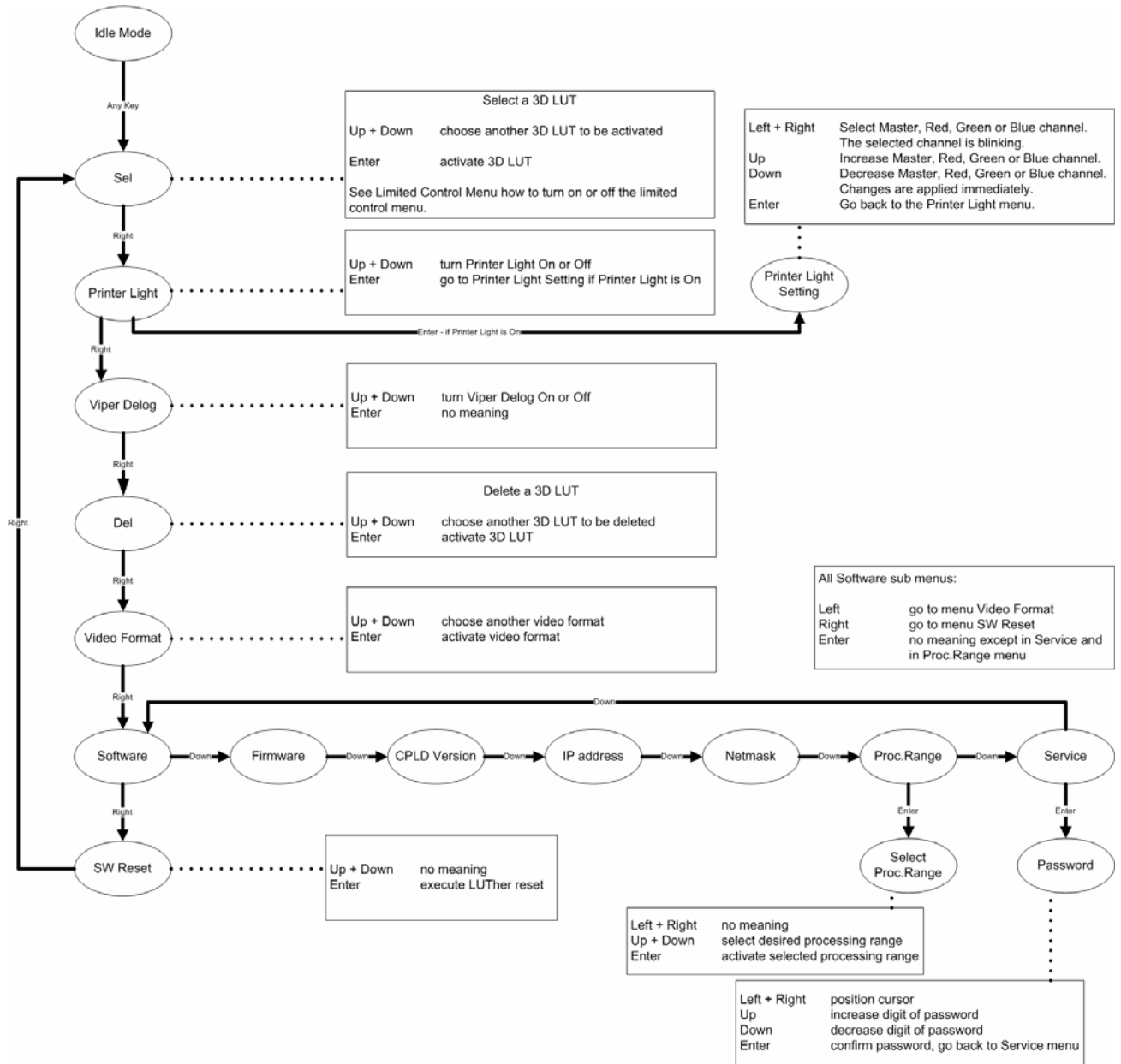


Figure 10 Menu Without a USB Stick and Deactivated Service Functions

In this figure and in the figure on the next page the buttons are shown how to go from one menu item to another menu item. For readability reason only one direction is displayed: the Right button to step through the main menu and the Down button to step through the Software menu. In reality both directions are supported. One can step through the main menu with the Right and Left button and one can step through the Software menu with the Down and Up button. This means for instance if the Sel menu item is

currently selected then the **SW Reset** menu will be selected after pressing the Left button. Pressing again the Left button will then select the **Software** menu item.

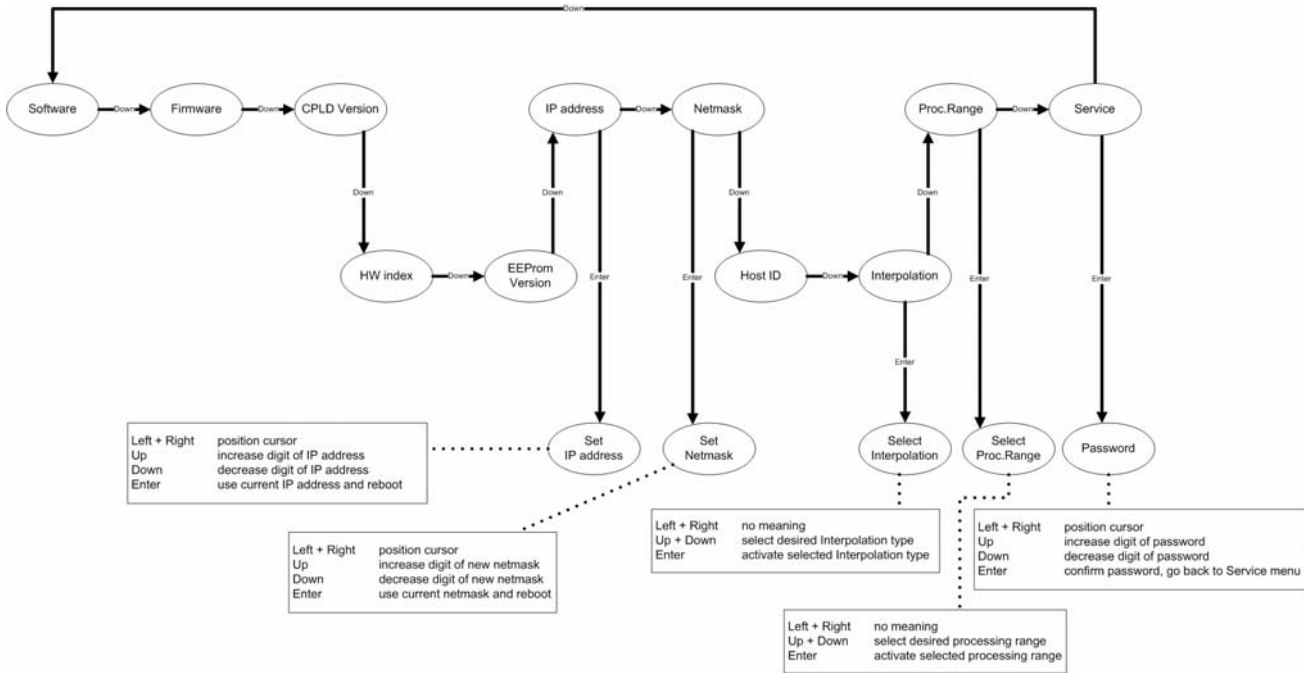


Figure 11 Menu With Activated Service Functions

This figure shows only the changes to the main menu when the service functions are activated. One can see some additional menu items as for instance the **HW index** and the **EEPROM Version** and also additional reactions when specific buttons are pressed (e.g. Enter button in the IP address menu item).

7.4.2 Menu With a USB Stick

The following menu items are selectable when a USB stick is connected:

- **Usb Lut:** to select an existing LUT stored on the USB stick in the directory **/Luts/** and to activate it.
- **Usb Fw:** to select a firmware version stored on the USB stick in the directory **/OperatingSoftware/** and to update LUTher
- **Usb Sw:** to select a control software version stored on the USB stick in the directory **/OperatingSoftware/** and to update LUTher
- **Software:** to display or to modify system settings
- **SW Reset:** to rest the video processing

Whenever a USB stick is connected the menu automatically changes from the menu described in [Section 7.4.1](#) to the menu described here.

If the **Usb Lut** menu item is chosen one can select the desired LUT, that is stored on the USB stick in an appropriate directory, with the up and down button. Once the desired LUT is displayed one can press the enter button to activate the LUT. A progress (**Loading LUT**) is shown on the display. The loaded LUT is stored in LUTher and is available thence without using the USB stick.

The **Usb Fw** menu item is a service function. If the service functions are not activated then this menu item is still selectable and one still sees the available firmware versions on the USB stick but one has to activate the service as described in [Section 8.3](#) before one can update a firmware version. If the **Usb Fw** menu item is selected one can choose with the up and down buttons the desired firmware version that has to be stored on the USB stick in an appropriate directory (**/OperatingSoftware/**). Pressing the Enter button will install the selected firmware version only if the service functions are activated. The new firmware version is then copied into LUTher and automatically loaded. It is available thence without using the USB stick.

The **Usb Sw** menu item is a service function. If the service functions are not activated then this menu item is still selectable and one still sees the available control software versions on the USB stick but one has to activate the service functions before a new control software version can be installed using the USB stick. If the **Usb Sw** menu item is selected one can choose with the up and down buttons the desired control software version that has to be stored on the USB stick in an appropriate directory (**/OperatingSoftware/**). Pressing the Enter button will install the selected control soft-

ware version only if the service functions are activated. The new control software version is copied into LUTher, automatically installed and started. It is available thence without using the USB stick.

The menu items **Software** and **SW Reset** have exactly the same functionality as described in [Section 7.4.1](#) when a USB stick is connected - this includes the dependency on whether the service functions are activated or not.

The following figure show all available menu items when a USB stick is connect to the LUTher and if the service functions are not activated. See [Figure 11 on page 48](#) to see the changes to this menu when the service functions are enabled.

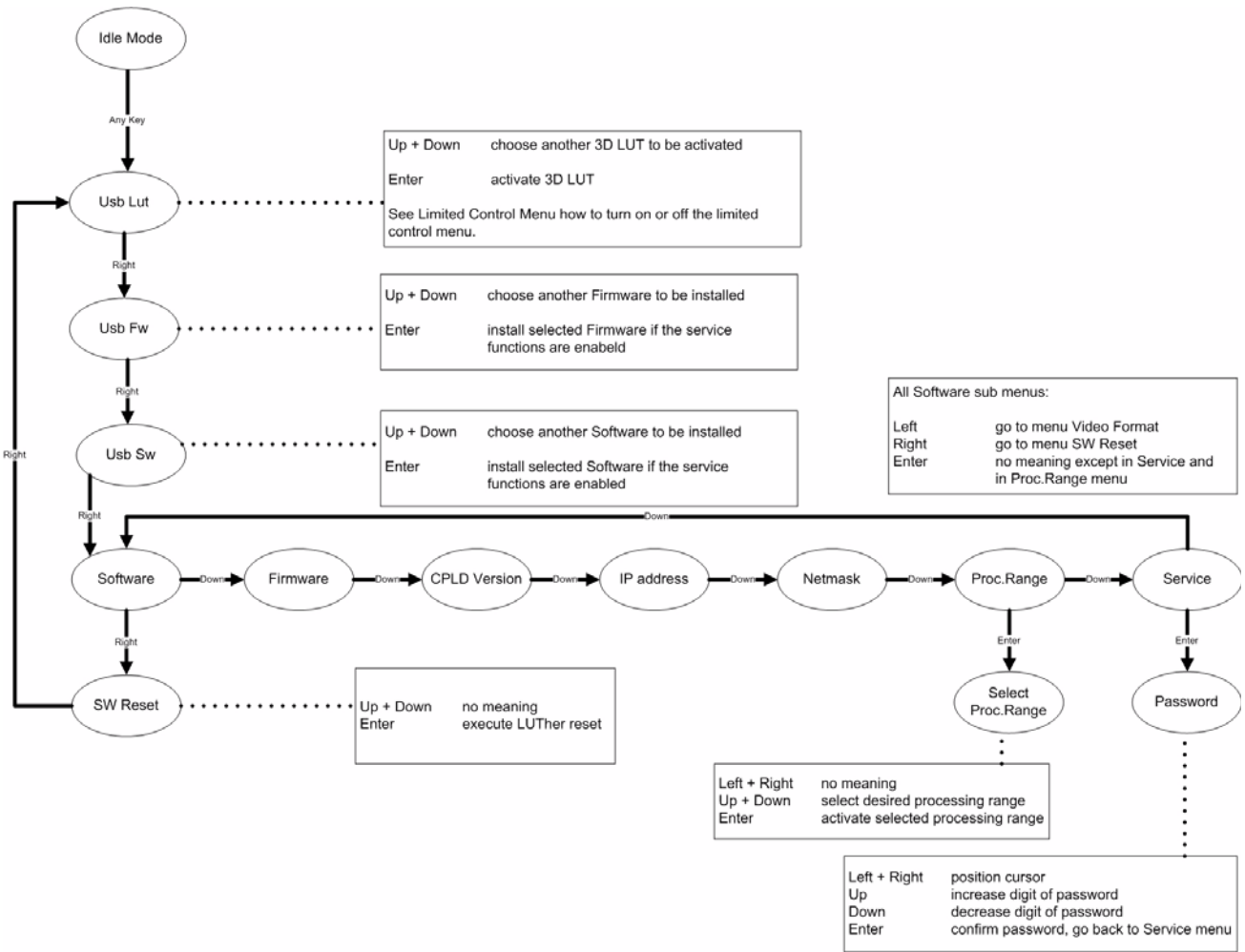


Figure 12 Menu With a USB Stick and Deactivated Service Functions

In this figure the buttons are shown how to go from one menu item to another menu item. For readability reason only one direction is displayed: the Right button to step through the main menu and the Down button to

step through the Software menu. In reality both directions are supported. One can step through the main menu with the Right and Left button and one can step through the Software menu with the Down and Up button. This means for instance if the **Usb Lut** menu item is currently selected then the **SW Reset** menu will be selected after pressing the Left button. Pressing again the Left button will then select the **Software** menu item.

7.4.3 Limited Control Menu

It is possible to restrict the menu to a **select 3D LUTs** only. If the limited control menu is activated only the menu to select a 3D LUT can be selected. All other menus are hidden and the Left and Right button are without any meaning. If a USB stick is connected only the menu **Usb Sel** and otherwise only the menu **Sel** is available.

It is always possible to activate and deactivate the limited control menu. Starting from the idle mode (wait at least 10 seconds without pressing any button) simple press any button to go either to the **Sel** menu (if no USB stick is connected) or to the **Usb Sel** menu (if a USB stick is connected). Then press the following buttons and keep them pressed down in the following order to activate or to deactivate the limited control menu. It is important press the buttons in the correct order and to not release any button before all four mentioned buttons are pressed down:

- press Down button down
- press Left button down
- press Up button down
- press Right button down

Now the limited control menu is either turned on or switched off and a message **Using full Control** or **Using Limited Control** is displayed at the front panel.

7.4.4 Menu Overview

The following table shows all menu items of the LUTher. The first two columns describe a menu item. The third column **Without USB stick** indicates, whether this menu item is available if no USB stick is connected (see [Section 7.4.1](#)). The next column **With USB stick** indicates if this menu is available if a USB stick is connected (see [Section 7.4.2](#)). The fifth column **Service Function** indicates if this menu is a special service function and thus only available if the service functions are activated.

Menu	Description	Without USB Stick	With USB Stick	Service Function
Sel	Select a 3D LUT	YES	NO	NO
Printer Light	Activate + Deactivate Printer Light function	YES	NO	NO
Printer Light Setting	Modify Printer Light settings	YES	NO	NO
Viper Delog	Activate + Deactivate Viper Delog function	YES	NO	NO
Del	Delete a 3D LUT	YES	NO	NO
Video Format	Select video format	YES	NO	NO
Software	Display current control software version	YES	YES	NO
Firmware	Display current firmware version	YES	YES	NO
CPLD	Display current CPLD version	YES	YES	NO
IP	Display IP address	YES	YES	NO
Mask	Display IP netmask	YES	YES	NO
Proc.Range	Display processing range	YES	YES	NO
Select Proc.Range	Change processing range	YES	YES	NO
Service	Display if service is activated	YES	YES	NO
Password	Enter password to activate service	YES	YES	NO
SW Reset	Execute a video reset	YES	YES	NO
HW Index	Display hardware index	YES	YES	YES
EEProm Version	Display EEPROM version	YES	YES	YES
Enter IP	Change IP address	YES	YES	YES
Enter Mask	Change IP Netmask	YES	YES	YES
HostID	Display and create HostID file	YES	YES	YES
Interpolation	Display interpolation type	YES	YES	YES
Select Interpolation	Change interpolation type	YES	YES	YES
Usb Lut	Select 3D LUT from a USB stick	NO	YES	NO
Usb Fw	Update Firmware from a USB stick	NO	YES	YES
Usb Sw	Update Software from a USB stick	NO	YES	YES

7.5 Bypass

The LUTher supports a bypass mode when running in Grass Valley mode. If the bypass mode is activated then no color space conversion takes place. The incoming video signal is bypassed through to the output of LUTher. This means that the Printer Light functionality, the 3D LUT and the Viper Delog functionality are bypassed. A video format conversion e.g. from RGB to 422YCC still takes place.

To switch on or off the bypass mode press the Enter button and keep it pressed down for approximately 3 seconds. This can be done no matter if the LUTher menu is currently idle or if another menu item is currently selected. If a menu item is selected and the bypass mode is either activated or deactivated than the menu automatically becomes idle.

In idle mode the name of the currently selected 3D LUT is displayed at the front panel of the LUTher if it is not in bypass mode. Otherwise instead of the 3D LUT name the text **Bypass** is displayed.

7.6 USB Stick

An USB stick is hot pluggable. The stick is mounted automatically when connected to LUTher and un-mounted when removed. It takes about ten seconds until a new connected USB stick is recognized - one can hear a short beep. After additional about ten seconds the USB related menu is available.

When a new USB stick is connected the first time the following directories are created:

- Lut
- OperatingSoftware
- Messages

The **Lut** directory is the one used by the **USB Lut** menu (see [Section 7.4.2](#)) and should contain valid LUTs.

The **OperatingSoftware** directory is the one used by the **USB Fw** and the **USB Sw** menu and should contain control software or firmware updates.

The **Messages** directory is intended to be used to copy log files from LUTher. Automatically copying log files is currently not supported.

It takes about 20 seconds after removing a USB stick until the standard menu as described in [Section 7.4.2](#) is selectable again.

7.7 Loading a LUT

A LUT can be loaded (activated) in three different ways:

- activating a LUT as described in [Section 7.4.1](#)
- loading a LUT from a USB stick (see [Section 7.4.2](#))
- copying a LUT using LAN as described in [Section 8.2](#)

A new user defined LUT can be successfully loaded if it is defined in the ASCII LUT file format as described in [Section 9.2](#) or if it is defined in the binary LUT file format as described in [Section 9.3](#).

Since LUTher offers an open LUT file format for individual LUT generation it is possible that one tries to load a LUT with an invalid format or with an unsupported format. That case a corresponding error message is displayed.

7.8 Error Handling

If an error occurs while loading a LUT then the error reason is displayed behind the LUT name. Possible reason is e.g. an invalid LUT format (see [Section 9](#)).

System Administration

8.1 Operating System

The pre-configured IP address is 192.168.20.170 and can be changed as described in section [Section 7.4.1](#).

8.2 Loading LUTs and Updating Firmware and Control Software

LUT's, new firmware versions and new control software versions can be loaded using LAN into LUTher. Therefore one has to ftp the corresponding file into the home directory of the user cocoftp (`/home/cocoftp/`) after logging in as user cocoftp.

The password for user cocoftp is **cocoftp**. New files are recognized and installed automatically.

Binary LUT files are recognized based in their name scheme **.lut** whereas ASCII LUT files are recognized based in their name scheme **.txt**. Please see [Section 9](#) for both file format descriptions.

Firmware files are recognized based on their name scheme **ds1011.xxx**, whereas xxx a version number is.

8.3 Activate Service Functions

Some menu functions are only enabled if the service functions are activated. Such a special service function is for instance the **Enter ID** menu. See also [Section 7.4.4](#) to get a list of all special service functions.

Only authorized personnel should activate the service functions.

Assuming the LUTher menu is idle, which is always the case when one does not press any button at the front panel for at least 10 seconds, then one can activate the service function with the following steps:

- select the Software menu e.g. by pressing three times the Left button
- select the Service menu e.g. by pressing one time the Up button

If the message **Service: yes** is displayed then the service functions are already activated and one can skip the following steps. If the message **Service: no** is displayed one has to enter the password, which is **1996**:

- press the Enter button to be able to enter a password

Now the message **Password: 0000** is displayed and the first digit of the password is blinking. One can now navigate through the digits with the Left and Right buttons and modify the digits with the Up and Down buttons. As soon as the password is entered one has to confirm this password with the Enter button. The following steps demonstrate how to enter this password:

- press once the Up button - the first digit is now **1**
- press once the Right button - the second digit is now blinking
- press once the Down button - the second digit is now **9**
- press once the Right button - the third digit is now blinking
- press once the Down button - the third digit is now **9**
- press once the Right button - the fourth digit is now blinking
- press four times the Down button - the fourth digit is now **6**
- press the Enter button

The service functions are now activated and the message **Service: yes** is displayed.

3D LUT Data File Definition

9.1 Scope

This standard defines a file format for the exchange of 3D LUT files between LUT generating systems and Grass Valley's LUTher.

The file extension will be `.txt` for an **ASCII file** (see [Section 9.2](#)) or `.lut` for a binary file (see [Section 9.3](#)).

9.2 ASCII 3D LUT Data File Definition

It is possible to load a human readable ASCII file into LUTher via USB stick or LAN as described in section 7.6 "Loading a LUT". Such a file has to have the file extension ".txt" and its content has to fulfill the following rules:

- The first line has to be:
channels: c3.
- The second line is optional and can be:
elements = <numberOfEntries>
where <numberOfEntries> is the number of the following R,G,B triples.
It corresponds to the LUT resolution:
 $\text{numberOfEntries} = (\text{LUT resolution} + 1)^3$.
For example, if the LUT resolution is 16 then the number of entries is 4913 (=17³).
See also in section [Section 9.3.3.2](#).
- Each of the <numberOfEntries> following lines has to contain three integer values in the range between 0 and 1023 and correspond to a R, G, B triple. The B value iterates at first followed by the G value and at last the R value iterates.
This means the first triple is R1, G1, B1 followed by R1, G1, B2 up to R<n>, G<n>, B<n>.
The integer values have to be separated with a white space (space or tab).

9.2.1 Example 3D LUT ASCII File

The following describes partly a one to one 3D LUT ASCII file with a resolution of 16. Only a few lines are shown here, all missing lines are indicated with a ...

This example (following page) demonstrates the iterating order of R, G and B:

```
#channels: c3
#entries = 4913
0          0    0
0          0   64
0          0  128
...        ...  ...
0          0 1023
0          64   0
0          64  64
0          64 128
...        ...  ...
0          64 1023
...        ...  ...
0          1023 1023
64         0    0
64         0   64
64         0  128
...        ...  ...
1023       1023 1023
```

9.3 Binary 3D LUT Data File Definition

LUT data is packed for efficient storage to pad to 32-bit word boundaries. Multibyte quantities may be stored with either the most significant byte first or the least significant byte first, where first means in the location with the lowest address, or the first byte in sequence from a byte-serial data channel. Both byte-order conventions are supported. The "magic number" in field 1 of the file information section is used to distinguish the byte order.

This flexible, resolution-independent file format describes 3D LUT with attributes defined in the binary file header. Each file represents a single 3D LUT.

9.3.1 Definitions

9.3.1.1 Magic Numbers

Indicates the start of the 3D LUT file and is used to determine byte order. The file format allows machines to create files in either of the two most common byte orders, whichever is easier for that machine. Byte-order translation is only required for machines reading files that were created on a machine with reverse byte order. Programs creating 3D LUT files should write the magic number with the ASCII value of 3LUT (0x334c5554 hex). Programs reading 3D LUT files should use the first four bytes to determine the byte order of the file. The first four bytes will be 3, L, U, T (0x334c5554 hex) if the byte order is most significant byte first, or T, U, L, 3 (0x54554c33 hex) if the byte order is least significant byte first.

9.3.1.2 Image File Size

Indicates the size of the entire file, i.e. containing header and 3D LUT data.

9.3.1.3 Creation Date Time

Is defined as yyyy:mm:dd:hh:mm:ssLTZ, formatted according to ISO 8601. [10] "LTZ" means "Local Time Zone;" format is: LTZ = Z (time zone = UTC), or LTZ = +/-hh, or LTZ = +/-hhmm (local time is offset from UTC).

9.3.1.4 Encryption Key

Indicates that the 3D LUT data is encrypted to prevent unauthorized use. The default is FFFFFFFF for no encryption. Any other value indicates that the 3D LUT data is encrypted and this value can be used as the encryption key. Note that the header data is not encrypted. [15].

9.3.2 File

The file contains four sections, the first three of which are header information.

1. Generic file information
2. 3D LUT information
3. User defined data
4. 3D LUT data

9.3.2.1 Types

Each field in the file header contains data of specified types. The valid types (and undefined values) for each field are:

Type	Undefined value
U8 unsigned 8-bit integer	FF hex
U16 unsigned 16-bit integer	FFFF hex
U32 unsigned 32-bit integer	FFFFFFFF hex
R32 32-bit real number (floating point)	FFFFFFFF hex
ASCII	0 hex (NULL character)

9.3.2.2 Rules

To provide a streamlined path for implementation and testing, a core set of field has been identified with a "C" in the field designation table. The rules necessary for interchange are:

- This core set contains the minimum amount of information that a reader needs to read and interpret a file.
- A core-compliant reader must read the core fields, but need not read the others.
- A core-compliant writer must fill the core fields with valid values (undefined values are not permitted). Non core fields must be filled with UNDEFINED values if the correct value is not known.

Unless stated otherwise, all references in this standard to binary data, sizes, offsets, and lengths are in units of bytes. Positions within the file are specified in terms of the number of bytes from the beginning of the file, with the first byte designated as byte 0. Offsets to individual fields are specified from the first byte.

All ASCII character strings that do not fill a whole field are terminated by a NULL (zero) byte.

9.3.3 Generic Headers

9.3.3.1 File Information Header

Field	Offset	Length	Type	Core	Content
1	0	4	U32	C	Magic Number (3D LUT ASCII)
2	4	4	U32	C	Offset to 3D LUT data in bytes
3	8	8	ASCII	C	Version number of header format (V1.0)
4	16	4	U32	C	Total LUT file size in bytes (including file header)
5	20	4	U32		Offset to Data field 1
6	24	4	U32		Offset to Data field 2
7	28	4	U32		Offset to Data field 3
8	32	4	U32		Offset to User-defined area (metadata)
9	36	100	ASCII		Filename
10	136	24	ASCII		Creation Date/Time yyyy:mm:dd:hh:mm:ssLTZ
11	160	100	ASCII		Creator
12	260	200	ASCII		Project Name
13	460	200	ASCII		Right to use or copyright statement
14	660	4	U32		Encryption key (FFFFFFFF unencrypted)
15	664	104	TBD		Reserved for future use

9.3.3.2 3D LUT Information Header

Field	Offset	Length	Type	Core	Content
16	768	2	U16	C	Resolution (see table 2)
17	770	2	U16	C	Bit depth (see table 3)
18	772	4	U32	C	Number of entries
19	776	32	TBD		Reserved for future use

If the number of entries is less than the given resolution all missing entries will be set to the max possible value (not valid at the moment).

For the moment all entries must be specified! The following table shows the required number of entries for a given resolution.

Resolution	Number of Entries
8	$9*9*9 = 729$
16	$17*17*17 = 4913$
32	$33*33*33 = 35937$
64	$65*65*65 = 274625$
128	$129*129*129 = 2146689$

Value	Resolution
3	LUT resolution is 8
4	LUT resolution is 16
5	LUT resolution is 32
6	LUT resolution is 64
7	LUT resolution is 128

Value	Resolution
0	8 Bit
1	10 Bit
2	12 Bit
3	16 Bit

Restriction!
Only 10 Bit is supported as Bit Depth for the moment.

9.3.3.3 User Defined Data

Field	Offset	Length	Type	Core	Content
20	??	4	U32		Data field 1 length in bytes
21		XX	TBD		Data field 1
22		4	U32		Data field 2 length in bytes
23		XX	TBD		Data field 2
24		4	U32		Data field 3 length in bytes
25		XX	TBD		Data field 3
26		4	U32		User defined area length in bytes
27		XX	TBD		User defined - metadata

The offset to the data fields and to the user defined can be specified in the Fields 5, 6, 7 and 8. An invalid offset is allowed, meaning that there is no data field or user defined area. If a valid offset value is given the corresponding fields 20, 22, 24 or 26 must be set. A length of 0 bytes is allowed.

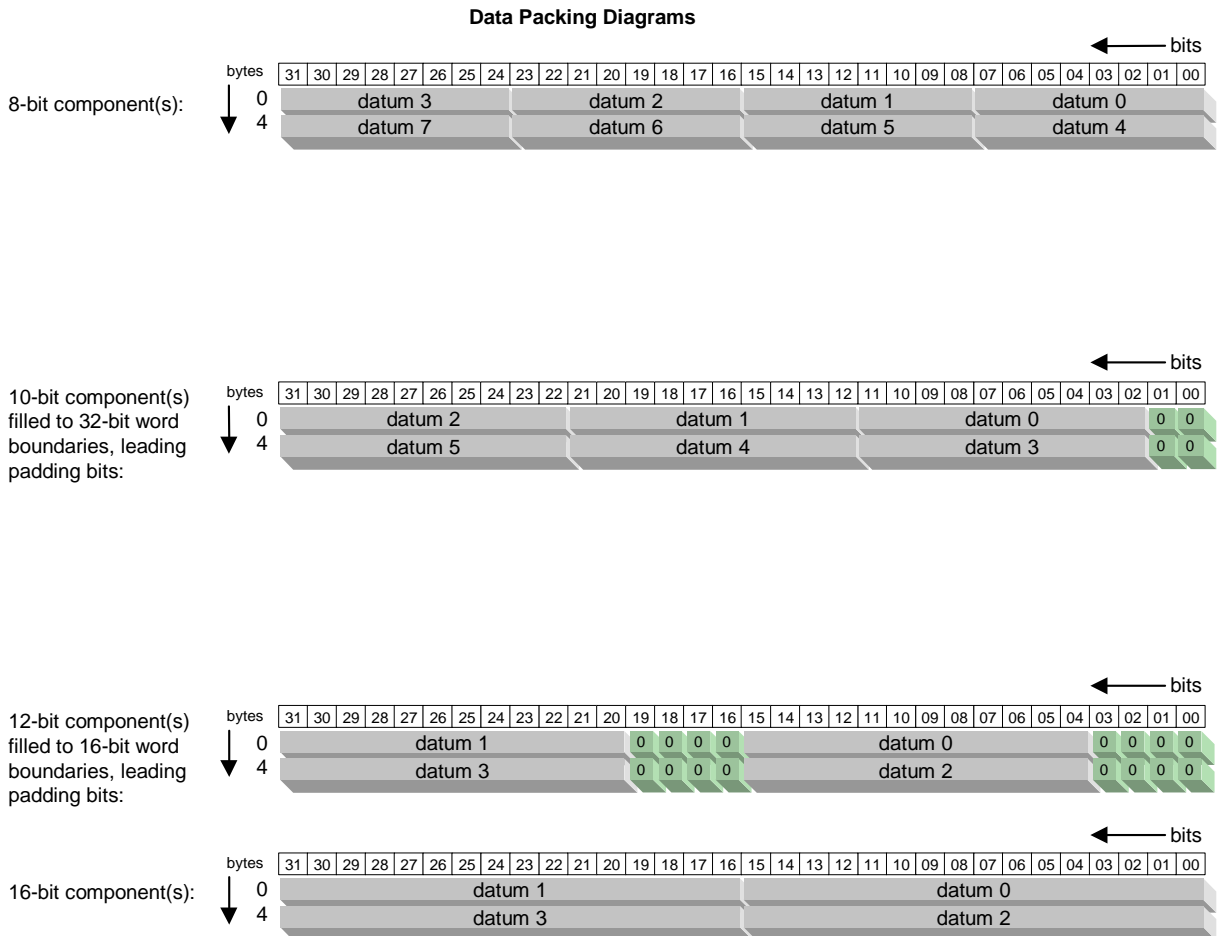
9.3.3.4 3D LUT Data

Field	Offset	Length	Type	Core	Content
28		XX	Array U8*4		3D LUT data must start at a block boundary of 1 k

The length of the 3D LUT data can be calculated with the 3D LUT header information. A 10bit LUT with 3 channels and a resolution of 129*129*129 results in a length of 4*129*129*129 bytes (= 8MB).

9.3.4 Data Packing Diagrams

These diagrams illustrate the packing of 8-, 10-, 12-, and 16-bit LUT values into 32-bit and 16 bit words, using the most-significant-byte-first convention.



Service Instructions

10.1 Functional Description of the „LUT Processor Board“

The LUT Processor Board contains three parts:

- Power Supply Part
- Controller Part
- Signal Processing Part

The LUT Processor Board needs a DC voltage of 5V.

It is delivered from the built-in Switch Mode Power Supply Unit of 75W.

10.1.1 The Power Supply Part on the LUT Processor Board

The Power Supply Part on the LUT Processor Board generates another 6 DC voltages, necessary for operation, with DC/DC Converter circuits.

These voltages are:

- 3.3V
- 2.5V
- 1.8V
- 1.5V
- VTT
- VREF

If one of these voltages fails (breaks down) it will be displayed by the adequate LED on the LUT Processor Board (the row of LEDs is positioned near to the front plate). Also all DC/DC Converter circuits become switched off.

10.1.2 The Controller part of the LUT Processor Board

The Controller Part of the LUT Processor Board consists of:

- one Single Board Computer, containing a Geode Processor with 266MHz and a 128Mbyte RAM
- one 40MB Hard Disk where the Operating System, the Operational Software and the Look-Up-Tables (LUT) are stored
- the Controller controls all Interfaces of the LUTer Box:
- LAN, USB, Display, User Buttons, VGA Monitor, PS2 (Mouse and Keyboard)
- further more, the Controller works as Interface to the Signal Processing Part, configures the Signal Processing Part with the adequate Firmware and stores the Look-Up-Table into the RAM.

10.1.3 The Signal Processing Part of the LUT Processor Board

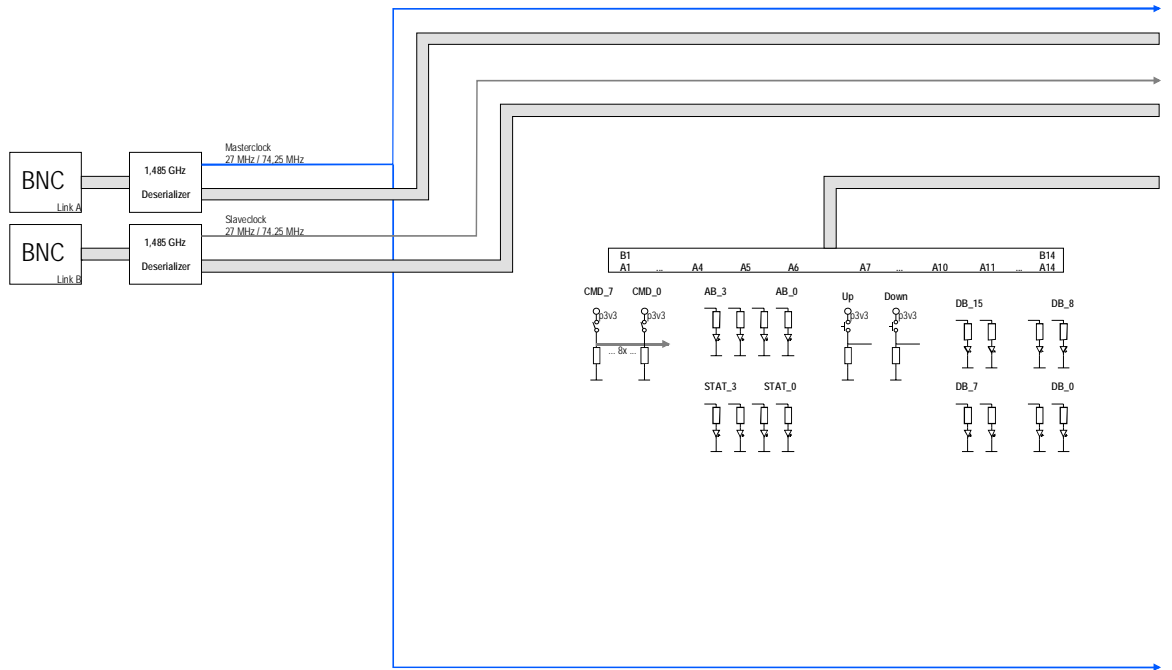
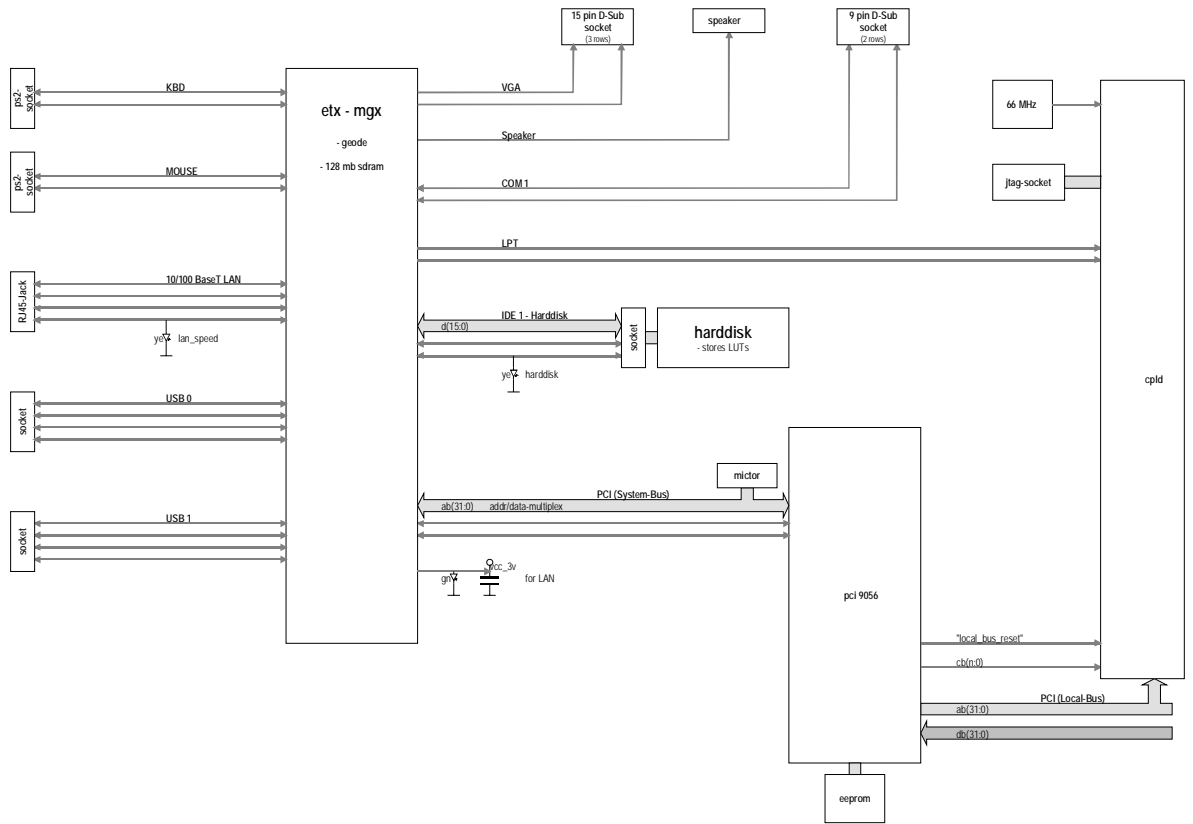
The Signal Processing Part of the LUT Processor Board consists of:

- one Video Input for serial-digital 4:4:4 / 4:2:2 Component SD/HD Video
- two Video Outputs for serial-digital 4:4:4 / 4:2:2 Component SD/HD Video
- Video Signal Converters (serial/parallel and parallel/serial)
- Video Processing Unit within one FPGA
- 0.75Gbyte RAM for Look-Up-Tables

The incoming serial Video Signal will be converted into a parallel format by the Video Signal Converter and led to the Video Processing Unit.

The Video Processing Unit, implemented in a FPGA, calculates for every incoming Video Pixel the adequate Output Value. This calculation is supported by the Look-Up-Table that is stored in the RAM. The parallel/serial Video Signal Converter generates a serial Video Data stream that is led to the Video Outputs.

See the block diagram on the pages below:



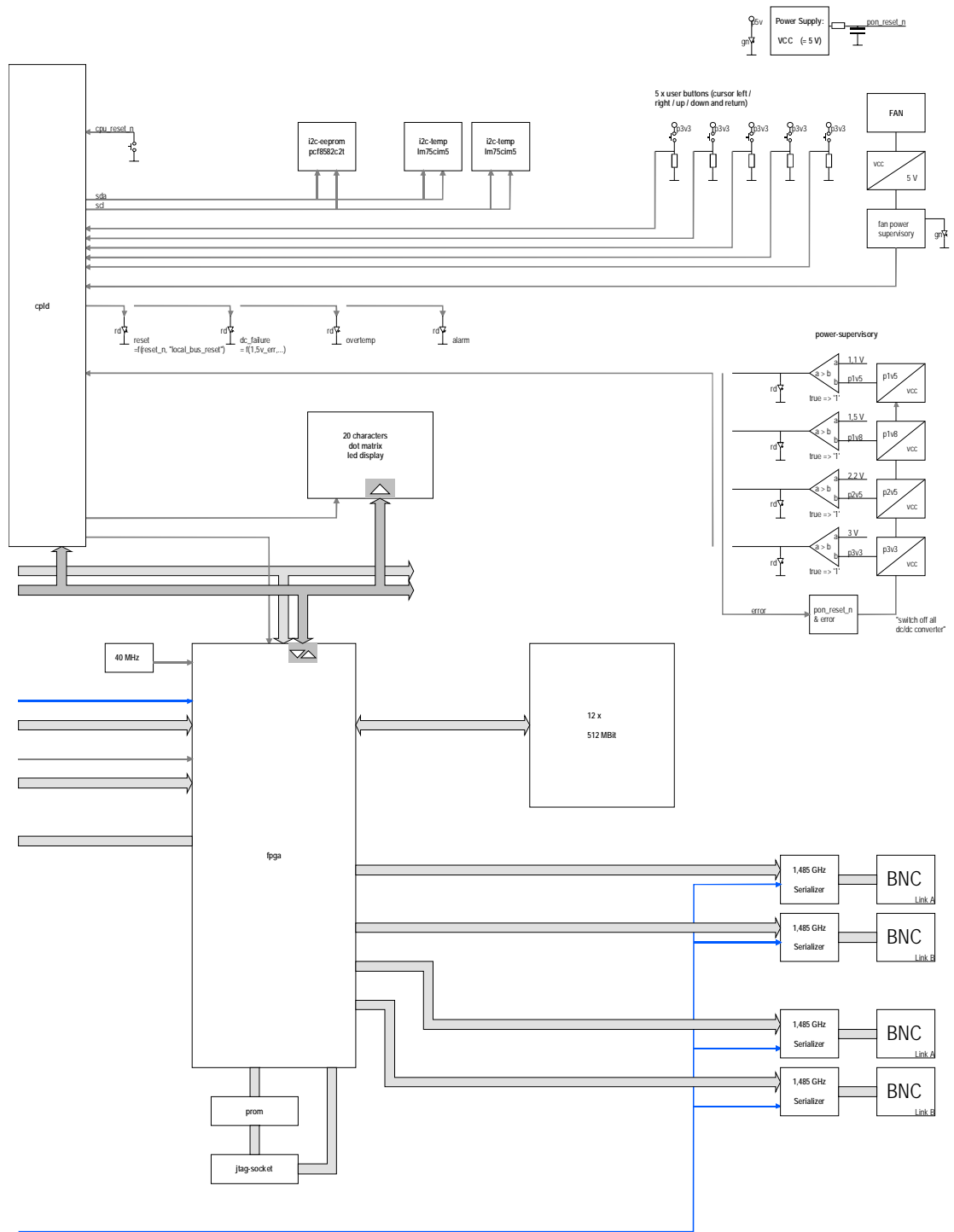


Figure 13 LUTher Block Diagram

10.1.4 Description of LEDs, Switches, Buttons and Connectors

10.1.4.1 Description of LEDs

FAN OK	The lit green LED FAN OK (G53) shows that both fans are in correct state. The LED is inactive when the rotational speed of one of the two fans falls below half nominal value.
CPLD-Status	The lit yellow LEDs CPLD-Status (G30-33) show SPARE .
HARDDISK	The lit yellow LED HARDDISK (G34) shows that the CPU accesses the hard disk (CPU executes hard disk accesses).
DC_FAIL	The lit red LED DC_FAIL (G35) shows that a power error occurred.
LAN	The blinking yellow LED LAN (G36) shows that LAN activity is detected.
VCC_3V_ETX	The lit green LED VCC_3V_ETX (G37) shows that the ETX single board computer generates the supply voltage of 3V for the CPU core.
ALARM	The lit red LED ALARM (G38) shows that a general hardware error was detected.
TEMP	The lit red LED TEMP Error (G39) shows that the temperature at one of the two temperature sensors exceeds a maximum value. In correct state, the LED is inactive.
RESET	The lit red LED RESET (G40) shows that a CPU reset was executed.
DONE	The lit green LED LCA_DONE (G41) shows the successful locking of the FPGA. LCA firmware is loaded correctly.
P1V5-ERR	The lit red LED P1V5-ERR (G43) shows that the 1.5V supply voltage falls below 1.31V or when a complete failure of the 1.5V supply voltage occurs. In the correct state, the LED is inactive.
P1V8-ERR	The lit red LED P1V8-ERR (G42) shows that the 1.8V supply voltage falls below 1.6V or when a complete failure of the 1.8V supply voltage occurs.

In the correct state, the LED is inactive.

P2V5-ERR

The lit red LED **P2V5-ERR** (G45) shows that the 2.5V supply voltage falls below 2.2V or when a complete failure of the 2.5V supply voltage occurs. In the correct state, the LED is inactive.

P3V3-ERR

The lit red LED **P3V3-ERR** (G44) shows that the 3.3V supply voltage falls below 3V or when a complete failure of the 3.3V supply voltage occurs. In the correct state, the LED is inactive.

VCC gt2V

The lit green LED **VCC gt2V** (G46) shows that the VCC supply voltage is greater than 2V.

VCC gt4V

The two lit green LED **VCC gt4V** (G51, 52) show that the VCC supply voltage is greater than 4V.

VTT-ERR

The lit red LED **VTT-ERR** (G50) shows that the VTT supply voltage falls below 1.1V or when a complete failure of the VTT supply voltage occurs. In the correct state, the LED is inactive.

VREF-ERR

The lit red LED **VREF-ERR** (G49) shows that the VREF supply voltage falls below 1.1V or when a complete failure of the VREF supply voltage occurs. In the correct state, the LED is inactive.

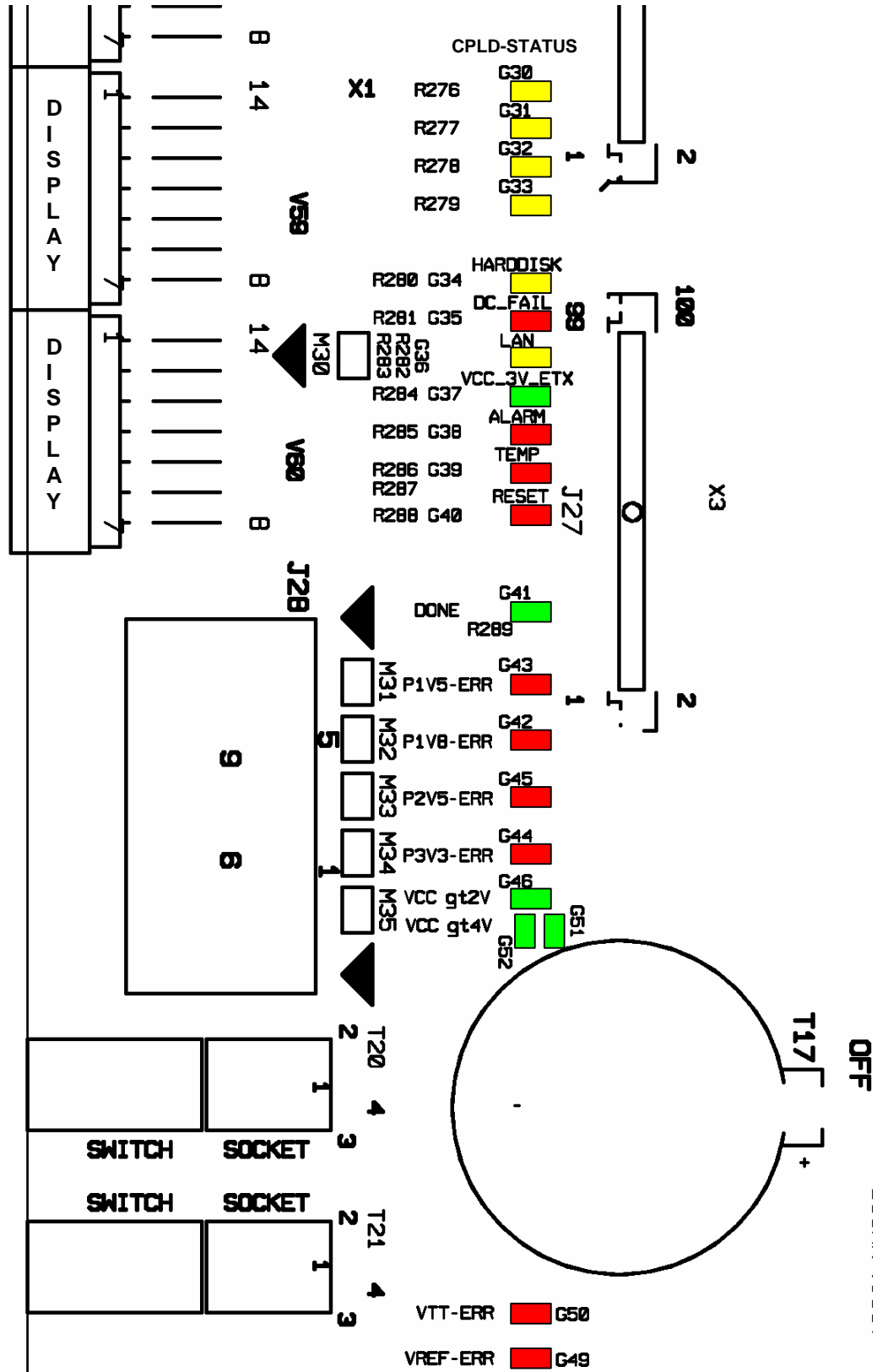


Figure 14 LEDs G30-52 (behind the displays of p.c.b. FY 4710)

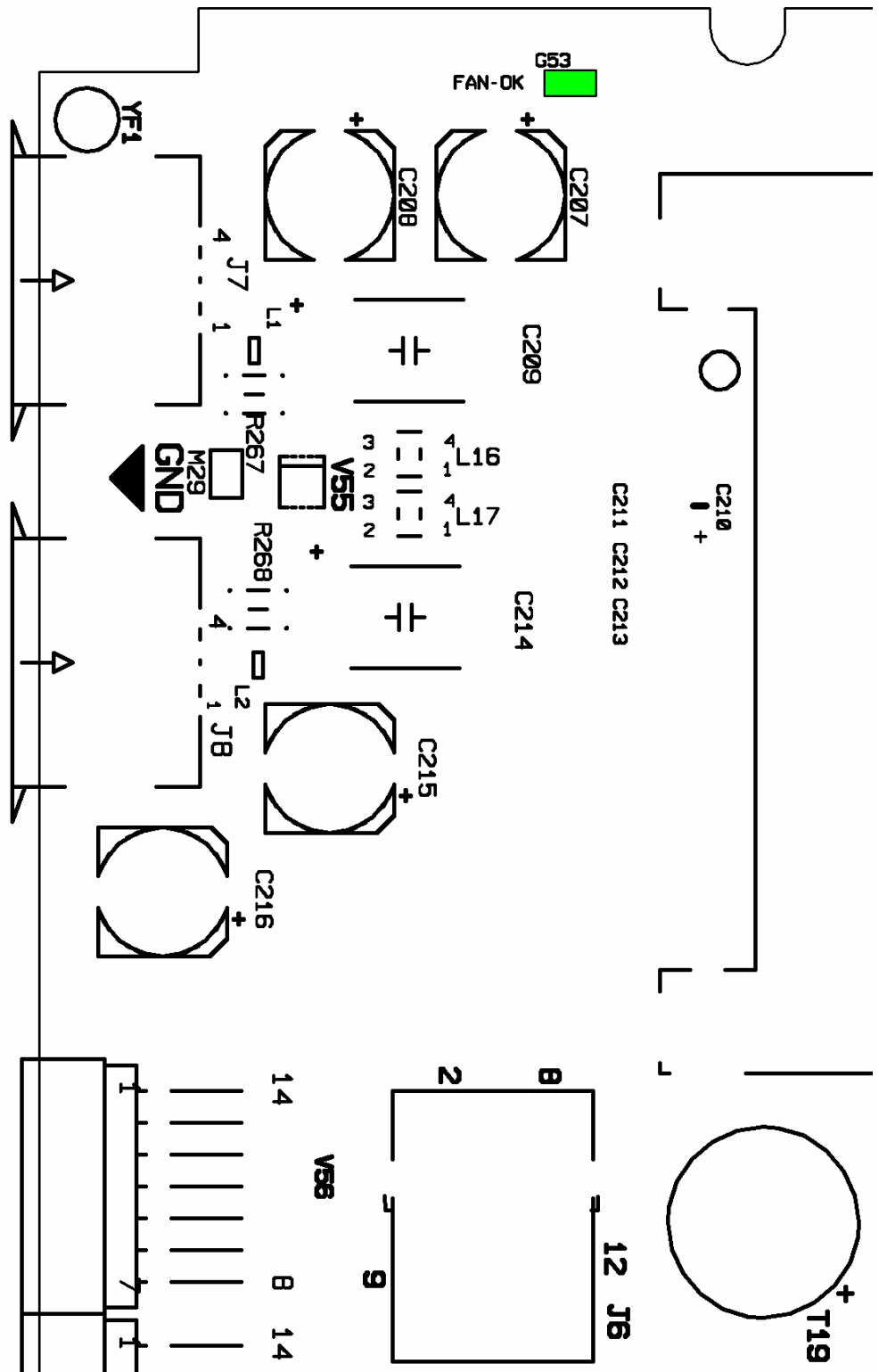


Figure 15 LED G53 (behind the USB front-connectors of p.c.b. FY 4710)

10.1.4.2 Description of Switches and Buttons

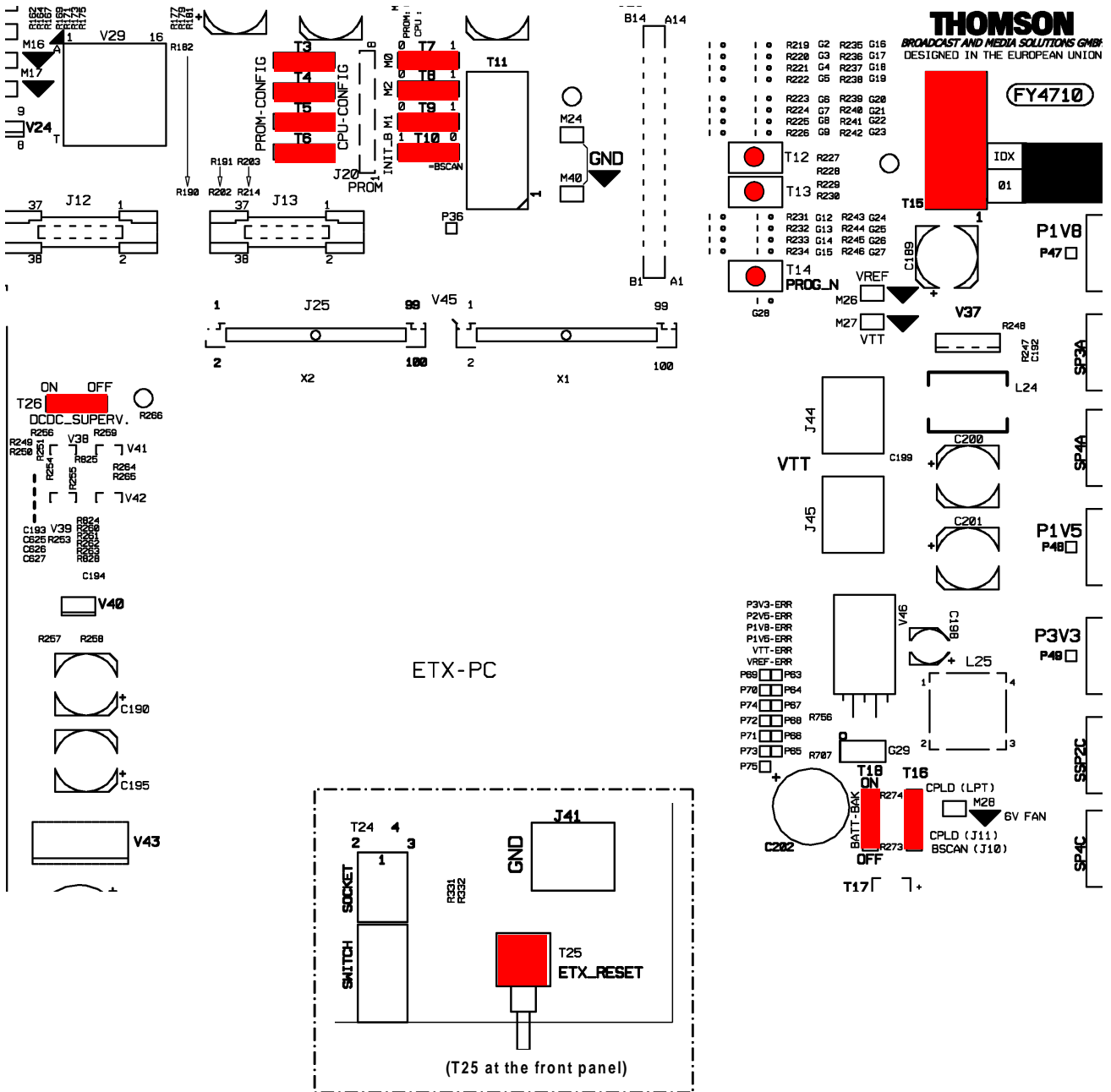
Switches T3-T6	<p>For firmware download from hard disk the switches (T3 - T6) have to be positioned to CPU-CONFIG.</p> <p>Note: For Boundary Scan Testing T3 has to be positioned to PROM-CONFIG. For firmware download from PROMs the switches (T3 - T6) have to be positioned to PROM-CONFIG.</p>
Switches T9,8,7	<p>Switch M1 (T9) and M2 (T8) have to be positioned to 1, switch M0 (T7) has to be positioned to 0. FPGA configuration mode: Slave Select Map Mode ("Slave Parallel Mode").</p>
Switch T10	<p>Switch INIT_B (T10) has to be positioned to 1: FPGA will be configured completely.</p> <p>For Boundary Scan Testing switch INIT_B (T10) has to be positioned to 0: FPGA configuration will be stopped after "Clear Memory", this is necessary for a Boundary Scan Testing.</p>
DIP-Switches T11	<p>All DIP switches (T11) have to be positioned to OFF. CPLD-Input: Spare.</p>
DIP-Switches T15	<p>All DIP switches (T15) have to be positioned to OFF. Debugging / Self Test / Diagnosis</p>
Switch T16	<p>CPLD can be programmed via the parallel interface of the CPU board:</p> <p>For the initial programming of the CPLD switch T16 has to be positioned to CPLD (J11).</p> <p>For Boundary Scan Testing switch T16 has to be positioned to BSCAN (J10).</p>
Switch T18	<p>The BATT-BAK switch (T18) has to be positioned to ON: Enable backup battery for ETX.</p>
Switch T26	<p>The switch DCDC-SUPERV. (T26) has to be positioned to ON: Enable Power Supervisory.</p>
Buttons T12, 13	<p>The buttons (T12, 13) serve for: Debugging / Self Test / Diagnosis.</p>

Button T14

The button **PROG-N** (T14) starts the FPGA configuration out of the PROM devices.

Button T25

The button **ETX_RESET** (T25, at the front panel) executes a reset of the GEODE Single Board Computer.



10.1.4.3 Description of Connectors

Connector J10

The **BSCAN** connector (J10) serves to execute Boundary Scan Testing.

Connector J11

The **CPLD** connector (J11) serves to program the CPLD.

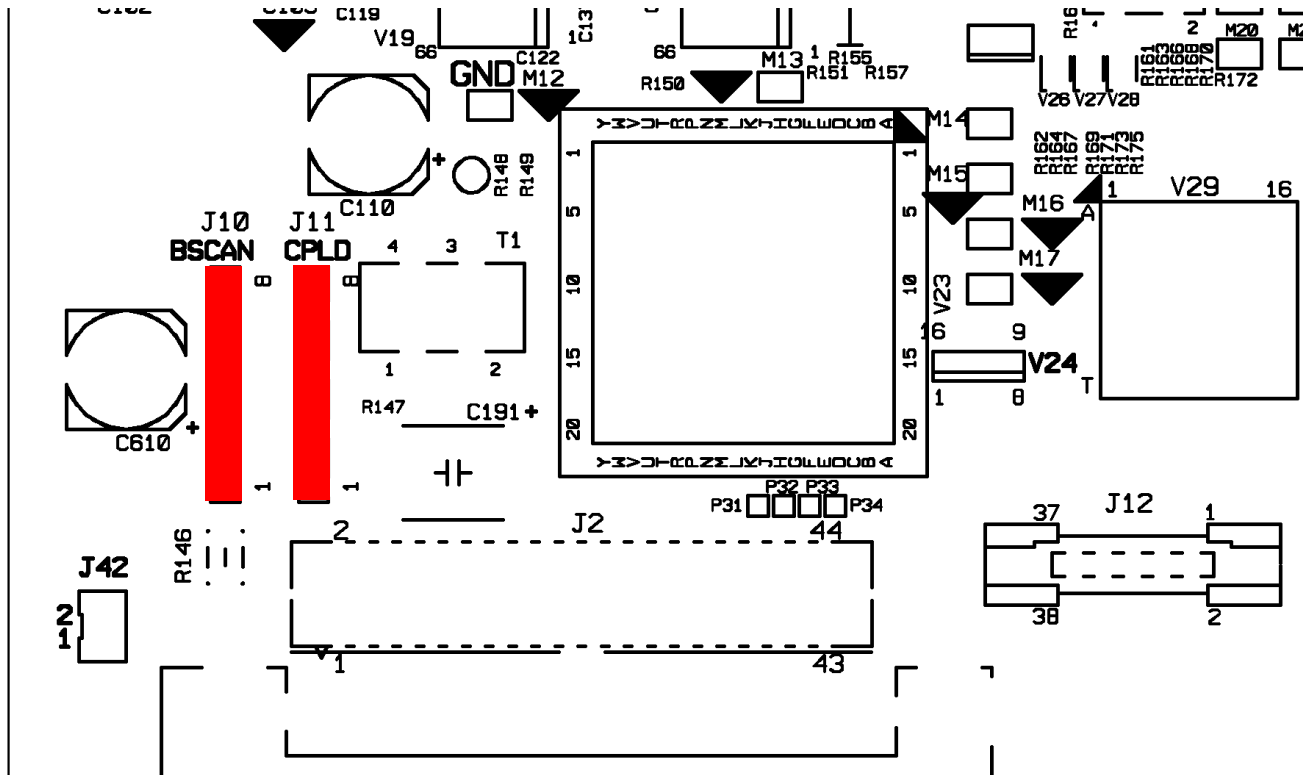


Figure 17 Connectors J10, J11 (at the left side of p.c.b. FY4710)

