



The Faroudja LD100/LD100U Line Doubler

Installation & Operation Instructions



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The Faroudja Laboratories LD100 Line Doubler is covered by the following United States patents: 4,030,121, 4,179,705, 4,240,105, 4,262,304, 4,847, 681, 4,864,389, 4,876,596, 4,893,176, 4,916,526, 4,967,271, 4,982,280, 4,989,090, 5,014,119, 5,025,312, 5,159,451, 5,237,414.

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Some Video History and the Faroudja Approach

Faroudja Laboratories, located in northern California's Silicon Valley, was founded in 1971 by Yves and Isabell Faroudja to develop state-of-the-art of video processing technology. Over the last 20 years, Faroudja Laboratories and its companion R&D center, Faroudja Research, have indeed developed hundreds of advanced electronic processes to improve video enhancement, noise reduction and NTSC encoding/ decoding technologies. Many of these processes are used under license by the world's leading electronics companies in a wide range of high performance video products. Faroudja professional video equipment is also currently hard at work in hundreds of television studios. Thus Faroudja technology is utilized and enjoyed in millions of American homes every day.

Yves Faroudja has devoted his career and his company to the goal of enabling home video systems to achieve the image quality of 35mm motion pictures. In pursuit of this goal, Faroudja Labs has made use of techniques from Faroudja professional video equipment and incorporated these in the LD100 and LD100U line doublers.

This booklet will provide the reader with a hands-on look at the LD100, its operation and benefits. Also supplied is an overview of the proprietary tech-

nologies utilized in this extraordinary device and an explanation of the visual improvements it provides in home video playback systems.

First, before we discuss the LD100, let's take a quick look at the history of the current television standard. Today's 525 line TV picture standard was actually developed in the 1940's when broadcasts were only in black and white. Keep in mind that back then, the transistor had not yet been invented! In 1953, the National Television Systems Committee (NTSC) adopted what is still the present method of color TV broadcasting. It was designed to be fully compatible with the older technology of black and white transmission. Unfortunately, this need to maintain compatibility with old technology led to unavoidable compromises in NTSC picture quality.

Today, thanks to the advent of new thinking and new technologies realized by industry pioneer Yves Faroudja, these compromises can be nearly eliminated. Faroudja's unique approach focuses on critical problem areas in the NTSC and PAL broadcast format. With patented engineering and design work, Yves and Faroudja Laboratories have created an exceptional product that brings new levels of visual reality to the enjoyment of discerning video enthusiasts around the world.



Licensees Around the World

Faroudja's inventive approach to improving the quality of video imaging has caught the eye of some of the world's greatest high technology companies. The following list represents those that have recognized the value of Faroudja's solutions to imaging problems and pay for the opportunity to incorporate this technology in their advanced video products (as of December 1993):

| | |
|------------------------|------------|
| Canon | Microtime |
| Conrac | Mitsubishi |
| General Instrument | NAC |
| Grass Valley | NEC |
| Hitachi | Sanyo |
| Ikegami | Sharp |
| JVC | Sony |
| Matsushita (Panasonic) | Toshiba |

Awards and Achievements

In just the last four years, Yves Faroudja and Faroudja Labs have garnered worldwide recognition and a number of industry awards. These honors are notable for several reasons. They are in response to the significant impact that Faroudja's technology has made on the serious improvement of video quality. They are also a reflection of his long term dedication to continually improving and optimizing the performance of the NTSC video format.

In chronological order, these awards and their specific focus are listed including an EMMY in 1991 for minimizing artifacts in the NTSC broadcast encoding process.

1987: SMPTE

DAVID SARNOFF GOLD MEDAL AWARD
for
"Contributing in Optimizing NTSC Performances"

1988: MONITOR AWARD

for
"Excellence in Engineering
NTSC Encoders and Decoders"

1989: BM/E AWARD

for
"Excellence in Engineering"

1991: Technology Executive of the Year from Cable TV Business

1991: EMMY

from The National Academy
of Television Arts and Sciences
for
"Techniques for Minimization of NTSC Artifacts
Through Advanced Encoding Techniques"

1992: VIDEO GRAND PRIX AWARD

Audio/Video International
LD100 Line Doubler "Advanced Technology Award"

1993: VIDEO MAGAZINE

Video Visionary
LD100 Line Doubler "10 Best Products"

SYSTEM DESCRIPTION



The Faroudja System LD100 digital scan converter is a precision video instrument used to convert NTSC Composite, Y/C, or 525 line RGB or Component interlaced signals into 525 line progressive outputs. Using the LD100 digital scan converter will produce pictures with more details, remove unwanted picture artifacts and, when used with projection systems, produce pictures of exceptional quality, giving a "cinema-like" feeling.

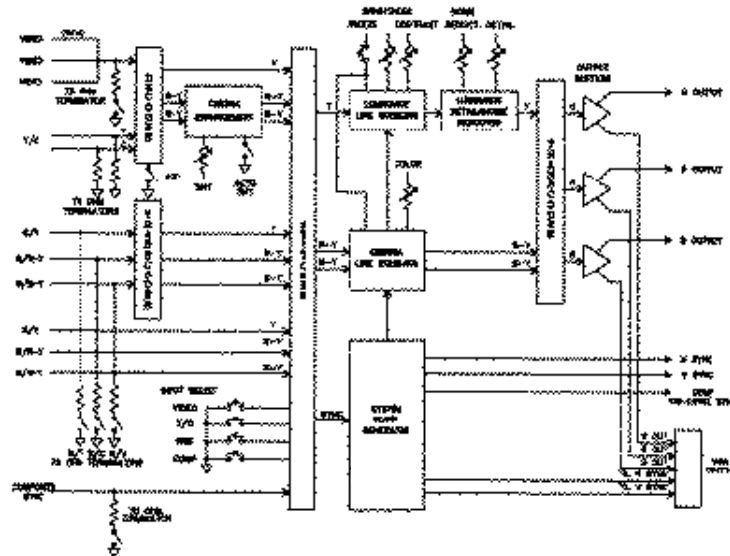
Front panel features include Power, Input Select (Video, Y/C, RGB and Component), Brightness, Contrast, Color, Auto-Tint, Noise Reduction, Detail, AGC and Freeze. Input switch settings are memorized when the power is removed from the unit. This allows the LD100 to be interfaced into a system without the need to select the input when the system is powered up. During power up, the AGC switch is selected in the On mode with the Freeze switch selected OFF. The remaining controls may be left in factory preset or manually set by pulling out and rotating the control until the desired level is established.

Inputs to the LD100 include: Composite Video, Y/C (S-VHS), RGB and Component (Y,R-Y,B-Y). The Video input may be connected by either a BNC connection or a video RCA type connection. These inputs are looped internally so that the signal may be used by other devices. A selectable 75 Ohm terminator switch is provided and should be in the ON

position if the input loop is not used. The Y/C input uses a standard 4 pin S-VHS connector. This input is not available for a looped operation and is terminated internally. The RGB and Component inputs use BNC connectors. As with the video input, these inputs are loopable to other devices. Selectable 75 Ohm terminations are provided. If the looped inputs are used, these cables should be kept short, (under 6' in length) or a video distribution amplifier should be used. This allows the LD100 to keep the highest signal bandwidth possible without having the high frequency being attenuated in a long cable.

Output from the LD100 is provided on six BNC connectors as well as one 15 pin 'D' VGA connector. The BNC outputs provided are Red, Green, Blue, Horizontal Sync, Vertical Sync and Composite Sync. Interface to monitors/projectors can be of a 4 or 5 wire connection. Note: 4 wire, meaning Red, Green, Blue and Composite Sync or 5 wire, meaning Red, Green, Blue, Horizontal Sync and Vertical Sync. There is no sync present on the Green output. The LD100 is capable of driving a monitor/projector using the BNC outputs as well as a VGA monitor using the 15 pin 'D' connector, at the same time.

The LD100 features a remote control interface that will allow control of all line doubler functions. The remote control uses a 25 pin female 'D' connector located on the rear panel. See appendix A for further information.



Circuit Description

Figure 1 is a block diagram of the LD100 showing signal flow and the location of front panel controls and switches. Composite Video and Y/C (S-VHS) inputs are connected to the units decoder with AGC control and converted to Y, R-Y and B-Y signals. The Y, (Luminance) output from the decoder enters the input switcher while the R-Y and B-Y signal enter the Chroma Enhancement block where the Tint phase can be adjusted when selected in the manual mode. The RGB input signals are trans-coded to Y, R-Y, and B-Y signals and fed to the input switcher. Component signals are fed directly to the input switcher.

The input switcher then selects the correct function and outputs the Y signal to the Luminance Line Doubler block. The Luminance Line Doubler block contains the Brightness, Contrast and Freeze controls while the R-Y and B-Y signals enter the Chroma Line Doubling block where the color level can be controlled along with the Freeze controls. The Line Doubled Luminance signal now enters the Luminance Detail and Noise Reduction block where the functions of Noise Reduction and Detail Level are controlled.

The Luminance signal from the Luminance Detail and Noise Reduction block along with the R-Y and B-Y signals from the Chroma Line Doubling block feed the output transcoder and are converted to RGB signals. These RGB signals are buffered and then sent to the rear panel outputs to both the BNC and VGA interface connectors.

When using the RGB or Component inputs, Sync is derived from the G or Y input signals unless sync is provided to the Composite Sync input. The Composite Sync input will override the sync from the G or Y inputs. The sync signal then feeds the LD100 systems clock generator and is used as a reference to generate Horizontal Sync, Vertical Sync, Composite Sync.

Inventory List

- 1 LD100 Digital Scan Converter
- 1 Installation/Operation Manual
- 1 Warranty Card
- 1 Power Cord
- 2 Rack Mount Ears
- 1 Rack Mount Screw Kit

Caution Notes

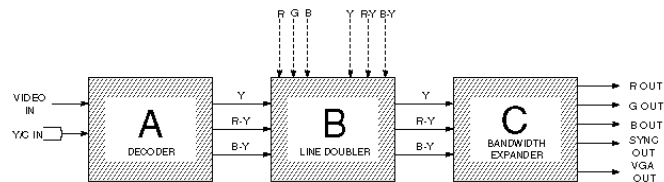
Do not connect the LD100 to a Monitor/ Projector not capable of the correct scan rates. (31.5KHz)

High Voltages are present inside. Opening the unit will void all warranties.

No user serviceable parts inside.

TECHNICAL HIGHLIGHTS

LD100 TECHNICAL HIGHLIGHTS – The LD100 is far more than simply a “line doubler”. It is a truly unique product in the world of high performance video. **The LD100 is actually a complex image processor that consists of three distinct components – all utilizing patented Faroudja technologies and engineered into one chassis; the SuperNTSC decoder, the Faroudja proprietary line doubler, and Faroudja’s innovative bandwidth expansion circuit that allows for the sharpening of image details.** Line doubling by itself is simple and inexpensive to achieve. But simply doubling the lines of information is worse than doing nothing at all because the visual result is a picture of lesser quality. To achieve film-like quality, a great deal more is required than just doubling the lines. The block diagram below provides a simple view of Faroudja’s multi-faceted solution for perfect pictures. The technical and visual benefits of each of these special circuits are explained more fully below.



LD100 BLOCK DIAGRAM

SECTION A – The LD100 SuperNTSC Decoder: Eliminates **COLOR BLURRING** – The engineers of the 1940’s (and the 1950’s, before and during the development of color broadcasting), had no idea that video images would one day be blown up as large as they are today. They therefore designed the color section of the NTSC standard with severe bandwidth restrictions. This causes colors in various video images to “blur” and “smear”. These effects are further aggravated by storage media, such as VHS tapes, that further degrade the chroma or color signal. e.g. – note how deep reds smear on VHS tape images.

The Faroudja LD100 utilizes proprietary circuitry to recreate and further correct color details. Technically, this is accomplished by making use of the sharper black and white transitions to develop a correction signal that is then used to sharpen the color transitions. The result is colors that are restored with sharp details and video images that retain their original crisp look.

RAINBOW PATTERNS – When you notice the fine detail of a striped referees shirt rippling with colored rainbows as the camera pans by, you’ve seen video cross-color interference.

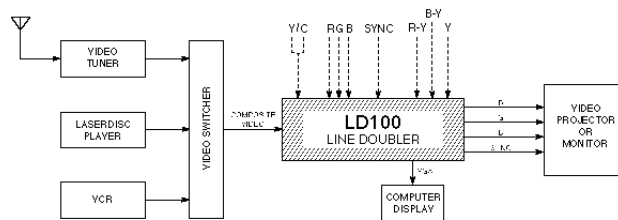
This annoying artifact is caused by imperfect separation of the color (chroma), and black and white (luminance) signals by the color decoder circuitry. Simple techniques used commonly to separate the two signals can be effective most of the time, but occasionally are fooled by finer pitch detail areas like the referees shirt. The decoder in the LD100 has patented digital adaptive comb filter circuitry that eliminates decoding errors of this type and enables the reproduction of sharper, cleaner color images.

DOT CRAWL and **HANGING DOTS** – This phenomena is easily seen with large, highly colored, stationary graphics like titles and credits. Dot crawl is a rapid upwards movement of colored dots on sharp vertical transitions. Hanging dots lie underneath all the colored horizontal transitions. Both of these color aberrations are artifacts that appear due to an imperfect color decoding process. The LD100 has two separate and patented correction circuits that work to eliminate both of these distortions. The impact is color transitions that are clear, sharp and natural.

SECTION B – THE LD100 Patented Line Doubler: eliminates **VISIBLE SCAN LINES** – The secret of the LD100’s uncanny ability to double the lines of information without adding digital artifacts is in its unique ability to detect motion and interpolate correctly to “fill in the blank lines”. The Faroudja LD100 does this better than any other line doubler thanks to its proprietary, patented circuitry. It is the only line doubler in existence that can detect the difference between a film image that has been transferred to video or video image that emanates from a video camera. After detecting the image type, the LD100 adjusts its algorithm to compensate accordingly.

This is critical because today’s home theaters are primarily used to show films that were transferred to video whether on tape, laserdisc or off the air (virtually all prime time programs are film transferred to video). The inability of other line doublers to detect motion correctly is what causes most of them to be unwatchable due to digital artifacts. The LD100 offers sharper, uniquely clean, artifact-free film-like images without visible scanning lines.

Historically speaking again, electrical engineers back in the 1940’s knew the resolution of a picture tube depends



TYPICAL LD100 SYSTEM UTILIZATION

on two different mechanisms. Horizontal resolution is a function of bandwidth (frequency response) of the circuitry while vertical resolution is a function of the scanning frequency (the number of scan lines in each picture). Given these mechanisms and the average size picture tube being 8-10", they designed the 525 line broadcast standard so that viewers would not see the scan lines when watching TV. They had no idea that someday people would be projecting home theater video images with diagonal screen sizes of 10' and more.

Based on those NTSC parameters, using a 10 ft. diagonal screen, would require the viewer to be located more than 45 ft. from the screen to see the picture as it was intended, without scan lines! Unfortunately, today's large screen installations have scan lines that are quite visible, especially with some of the latest high resolution monitors and projection televisions. The LD100 eliminates this problem by scan doubling, or digitally doubling the 525 lines to become 1050 lines. The result is the elimination of visible scan lines. The image produced by the LD100 is clearer, continuous and virtually film-like.

SECTION C – The LD100 Bandwidth Expansion Circuitry: **SHARPENING OF THE IMAGE DETAILS** – There is a major limitation with most contemporary NTSC program sources — lack of frequency response. The best video sources such as satellite dish reception and laserdiscs can provide acceptable resolution (400 plus lines of horizontal resolution). Other more common sources however, such as VHS tapes (230 lines), are clearly deficient. The problem is compounded when one doubles the scan lines and performs other signal processing. The lack of high frequency detail becomes very obvious with almost all

sources. The resultant picture is free of scan lines but dull, with a serious loss of definition. The solution is to expand the high frequencies without producing annoying and picture degrading artifacts.

The bandwidth expansion circuitry in the LD100 is exceptionally sophisticated, using Faroudja's double differentiation techniques to sharpen the edges of both horizontal and vertical details. The result is a sharply detailed line doubled image that appears crisp and three dimensional with no visible negative side-effects. This process can effectively double the bandwidth and therefore the resolution of the incoming signal.

FAROUDJA LD100 APPLICATIONS – While the technical accomplishments of the LD100 represent years of intense research and development, its use is straightforward and direct. The block diagram (above), illustrates a typical home theater system configuration and shows how the LD100 would be inserted in the signal path. Many entertainment sources benefit greatly by the LD100's unique attributes; laserdisc, VHS video, S-VHS video, cable TV, broadcast TV, etc. The LD100 has proven to be an invaluable tool in other presentation disciplines where image quality is important – computer data displays, professional installations in boardrooms and media rooms, military installations, government agencies and academic uses in schools and colleges. From the quality of its individual parts to its state-of-the-art patented circuitry, the LD100 is truly in a class by itself. There is simply no finer video processor available . . . at any price!

NOTE: The LD100 (NTSC only version) operates properly with 50Hz 625 line component or RGB sources.

INSTALLATION INSTRUCTIONS

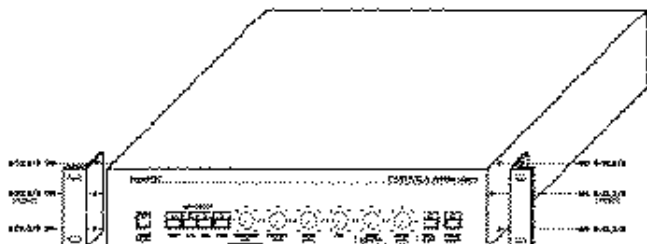


Figure 2

Unpacking

Remove the LD100/LD100U from the shipping container and examine it for any signs of shipping damage or missing items, (check inventory list on page 5).

All shipping materials should be saved if the unit is to be moved or should need to be returned for service or repair.

Installation

The LD100/LD100U is designed to be placed on the table or rack mounted. If the rack mounting installation kit is to be used, the rack mount ears are installed by removing the 4 screws retaining the wood side panels and installing the rack mount ears using the 3 screws as shown in Figure 2. Remove the four feet from the unit. When installing the LD100 in a rack, it will be necessary to support the LD100/LD100U by using rack support rails supplied by the rack manufacturer.

Do not support the LD100/LD100U by the rack mount ears alone!

Ventilation

The LD100/LD100U will require that air flows freely in both the bottom and top vent holes. Blocking these holes will greatly reduce the reliability of the unit and lead to the possibility of overheating.

When the LD100/LD100U is rack mounted, a minimum of 1.25" (1 rack unit height) of free space is to be provided for both the top and bottom of the unit

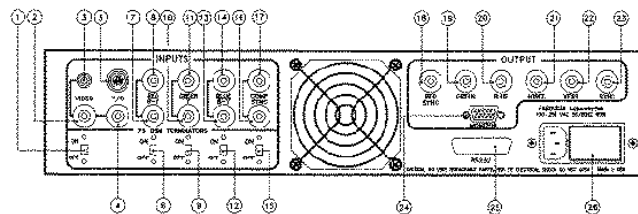


Figure 3

to allow for proper cooling. It is also recommended that the rack be forced air cooled.

Rear Panel I/O

1. **Video Termination Switch** – Select ON when not looping the Video signal to other video devices, (75 Ohm).
2. **Video Input (BNC)** – Composite Video Input
3. **Video Input (RCA)** – Composite Video Input
4. **Video Input (BNC)** – Composite Video Input Loop
5. **Y/C Input (4 Pin)** – Y/C, input internally terminated.
6. **R/R-Y Termination Switch** – Select ON when not looping the R/V signal to other video devices, (75 Ohm).
7. **R/R-Y Input Loop (BNC)** – Red/R-Y Input
8. **R/R-Y Input (BNC)** – Red/R-Y Input
9. **G/Y Termination Switch** – Select ON when not looping the G/Y signal to other video devices, (75 Ohm).
10. **G/Y Input Loop (BNC)** – Green/Y Input
11. **G/Y Input (BNC)** – Green/Y Input
12. **B/B-Y Termination Switch** – Select ON when not looping the B/B-Y signal to other video devices, (75 Ohm).
13. **B/B-Y Input Loop (BNC)** – Blue/B-Y Input
14. **B/B-Y Input (BNC)** – Blue/B-Y Input

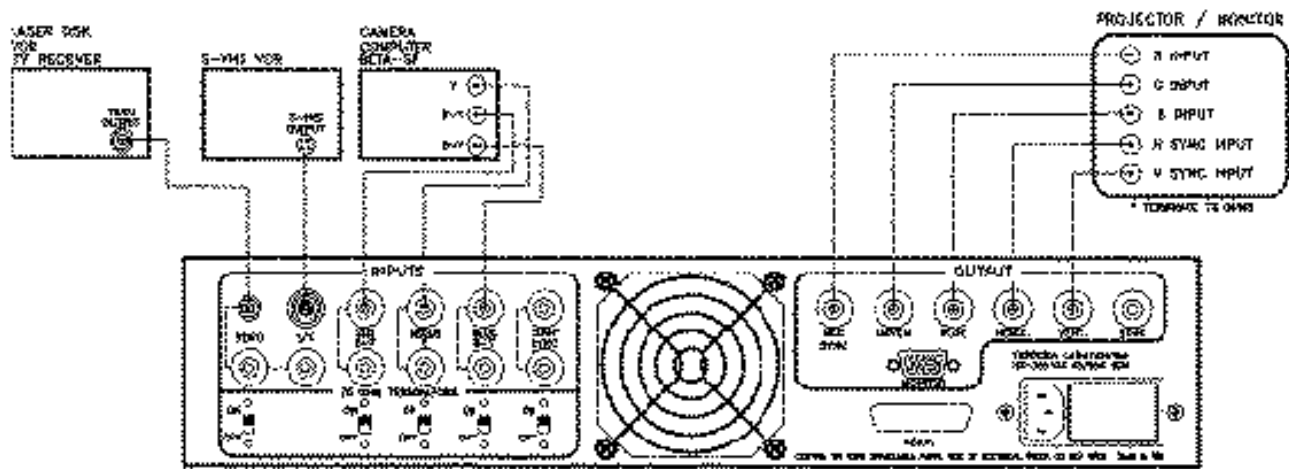


Figure 4

15. **Sync Termination Switch** – Select ON when not looping the Composite Sync signal to other video devices, (75 Ohm).
16. **Sync Input Loop (BNC)** – Composite Sync Input Loop
17. **Sync Input (BNC)** – Composite Sync Input
18. **Red Output (BNC)** – Red Output 714mV
19. **Green Output (BNC)** – Green Output 714mV
20. **Blue Output (BNC)** – Blue Output 714mV
21. **Horiz. Sync Output (BNC)** – Horizontal Sync Output –4Vp-p, 31.5KHz/31.2KHz
22. **Vert. Sync Output (BNC)** – Vertical Sync Output –4Vp-p, 59.49Hz/50Hz
23. **Sync Output (BNC)** – Composite Sync Output –4Vp-p
24. **VGA Interface Output** – VGA Standard using Positive TTL Sync Levels. See appendix B for pinout information.
25. **Remote Control Interface** – See appendix A for interface diagrams.
26. **Power Input** – 100-250 VAC, 50/60Hz, 60W

Interface

Figure 4 diagrams the installation of the LD100 using inputs from:

1. A composite source such as a Laser Disk Player, VCR or TV Receiver.
2. A Y/C input such as a S-VHS VCR.
3. An RGB input with sync on green or a Component input such as a Camera or Beta-SP recorder with sync on Y. If sync on green or sync on Y is not available then Sync can be interfaced using the Composite sync input.

All input with the exception of the Y/C input have selectable 75 Ohm input termination switches. These switches are to be in the ON position unless the LD100 is being used in a looped configuration. Termination is then located at the last unit in the loop only.

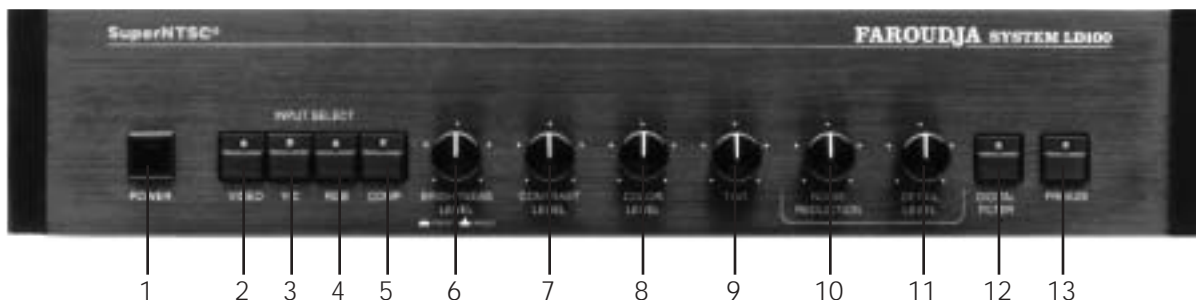
Note: The diagram shows a 5 wire connection to the monitor/projector, i.e. Red, Green, Blue, Horizontal Sync and Vertical Sync. For monitors/projectors with a 4 wire input, use Red, Green, Blue and Composite Sync outputs.

The monitor/projector will be terminated at 75 Ohm either internally or by switches located on the monitor/projector.

LINE DOUBLER OPERATING INSTRUCTIONS

For reasons of clarity, this technical overview has been written specifically for the LD100. This description applies as well to the LD100U, with the following exceptions:

1. The LD100U accepts PAL and NTSC signals and switches automatically to the proper standard.
2. Tint control is not operational with PAL sources.



The LD100 Control panel

Selecting a push button control lights the adjacent LED to indicate activation or selection of that particular function.

- 1) **Power ON/OFF** – Press the button and the LED lights green to indicate POWER ON. When the LD100 powers up it is automatically set to operate just as it was when it was last turned off. The Detail Enhancement circuits are automatically engaged at turn on.

Power ON/OFF - OFF – Another push on the switch and the power is cut off extinguishing the green LED. The Freeze Circuit is automatically disengaged, if in use, upon turn off.

INPUT SELECTION SWITCHES (4)

- 2) **Video** – refers to any composite NTSC video input - (e.g. VCR's, laserdisc players, cable boxes, etc.) Press to select the Video input.
- 3) **Y/C** – Y/C refers to any Super-VHS (S-VHS or Hi-8) inputs - (e.g. laserdisc players, S-VHS or Hi-8 video tape recorders, satellite receivers, etc.) Press to select the Y/C input. Using the Y/C input on the LD100 allows one to realize all the benefits of maintaining the separation of the luminance (picture) and chrominance (color) signal through the video signal processing chain, thus avoiding rainbow patterns due to cross color interference.
- 4) **RGB** – RGB refers to the incoming video signal being broken down to the individual red, green and blue format more typically found in the professional and broadcast area. The most common

use of this input is computers (running at 15.75 kHz). Press to select the RGB video input.

- 5) **Component Input** – Component Inputs are more commonly used in the broadcast studio or post-production environment. The video signal in its component form (Y, R-Y, B-Y) is carried in a 3-wire cable with BNC type connectors (e.g. MII™, D1, Betacam™, Betacam SP™, etc.). Press to select the Component video input.

PICTURE CONTROLS (4)

The four rotary-style picture controls, **BRIGHTNESS, CONTRAST, COLOR** and **TINT**, are factory preset when pushed in. When pulled out they become active for manual adjustment. Pushing the knob back in after manual adjustment gives you the opportunity to compare your setting to the factory preset(s).

The rotary control format allows for a high degree of tactile feedback when one is adjusting the picture functions. Additionally, these controls provide a wider range of adjustment than those typically found on monitors and televisions.

In addition, automatic chroma level and phase controls (ACC and APC) are provided. As a consequence, all source-to-source variations in chroma phase and level are corrected.

When the signal is fed to a monitor through the RGB inputs the monitor color and tint controls are typically bypassed. Incorporating the LD100 in such a system, with its broad range controls, restores and enhances this control flexibility.

Every LD100 is subjected to an intense battery of QC and environmental tests. Then each unit is re-tested and re-calibrated for optimum performance. The component parts used in the LD100 are the finest available, ensuring long term consistent performance and reliability. This unique, quality oriented "Faroudja touch" can also be seen in the design of many of the LD100's controls and features.

- 6) **Brightness Level** – Known as "Set-up" in the broadcast industry, the BRIGHTNESS control is used to set up the background black level. Pull the knob out and turn fully counter clockwise until the picture goes dark. Then rotate the control clockwise until the black areas in the picture just begin to go gray. Turn the control back counter clockwise until the gray just goes to black. This is the optimum setting.
- 7) **Contrast Level** – As the BRIGHTNESS control sets the background black level, the CONTRAST control sets the foreground white level. First set the BRIGHTNESS level as above, then pull out and rotate the CONTRAST level clockwise, starting at the full counter clockwise position, until the white areas of the picture are clearly obvious.
- 8) **Color level** – With the Color control pressed in, the LD100 uses its internal AGC, (Automatic Gain Control) to set the color level. Pull the knob out and starting from the full counter-clockwise position, rotate clockwise for increased color saturation. This is a subjective setting, there is no right or wrong. Simply adjust for the most pleasing color level.
- 9) **Tint** – Also known as "Hue" or "Phase", pull the knob out to adjust to your personal taste, particularly in flesh tones. Adjusting the tint control shifts the picture towards the green or red areas of the color spectrum. Tint is only active in the video or Y/C input modes. With the control pressed in, the LD100 is in the Auto-Tint mode. The Auto-Tint mode is achieved by using internal phase comparison techniques to automatically display colors as intended.

IMAGE SHARPNESS CONTROLS (2)

The two rotary-style Image Sharpness controls, NOISE REDUCTION and DETAIL LEVEL, work together to sharpen edge transitions for a "punchier" picture. The proprietary bandwidth expansion circuitry contained in the LD100 is critical to its spectacular performance. Typical line doublers produce a flat, soft picture. The LD100's Image Sharpness circuitry improves the sharp line and edge transitions making for clearer, more vivid video images. This is accomplished with the two controls working in tandem, without adding video noise or digital artifacts which could otherwise degrade the picture.

- 10) **Noise Reduction** – After setting the detail level (11), the noise reduction control is then used to remove any residual noise that may be added during the Image Sharpness process.
- 11) **Detail Level** – To set the detail level start full counter clockwise and add detail until the edge transitions just begin to sharpen.
- 12) **Digital Filter** – The Digital Filter eliminates compression artifacts generated by video sources transmitted via a digital compressed path and should not be used with conventional video sources.
- 13) **Freeze On/Off** – Press to capture the current picture displayed on the screen. Press again to return to normal, active video. The freeze mode digitally captures the incoming video signal and holds it for critical viewing and adjustment. This feature allows you to optimize the LD100 picture controls on a still, constant image of your choosing.

MII is a registered trademark of Panasonic. Betacam and Betacam SP are registered trademarks of Sony.

TROUBLESHOOTING

| Problem | Solution |
|--------------------|---|
| No power light | Unit not turned on Unit not plugged in Fuse blown No power at plug |
| No picture | Video source not selected No video source connected or operating Projector/Monitor not turned on Projector/Monitor not connected correctly Bad video cable Unit in freeze mode Check brightness and contrast levels |
| Colors bleeding | Check LD100 termination Check projector/monitor termination Contrast set too high Color set too high |
| Picture not stable | Check interface cables Sync cables are swapped or not connected Input source not selected correctly Check input terminations Set Sync to STD. Projector Fast/Slow Horizontal time constant. Should be set to fast. |
| Incorrect colors | Tint in manual mode Defective output cable RGB cables are swapped Check projector/monitor termination Input source not selected correctly No burst on input RGB or Y,R-Y, B-Y Inputs not terminated. |
| Picture washed out | Composite input not terminated |

NOTE: To make sure that an input source is not the cause of a problem for a composite source, turn the termination switch off and connect a composite monitor to the composite input Loop input. For a R,G,B input source, turn the three termination switches off and connect a R,G,B monitor to the R,G,B input Loop input.

To make sure that a projector is not the cause of a problem, connect a VGA monitor to the 15pin VGA output connector and check the display to see if it is correct and if the projector is the problem. If the monitor display shows the same problem as the projector display, then the line doubler has a problem and you should contact our Technical Support Department.

LD100/LD100U Remote Control Operation

Overview

Remote control of the LD100 / LD100U Line Doubler is provided by an RS-232 serial interface connector located on the rear panel of the unit. An external controller such as a computer or integrated system controller with an RS-232 interface may be used to control all user accessible functions of the Line Doubler.

RS-232 controllable functions include: Video, Y/C (S-VHS), RGB, Component (YUV), Brightness, Contrast, Color, Tint, Noise Reduction, Detail Level, Auto-Tint, Digital Filter On/Off, Freeze On/Off, Echo On/Off, Help, Status and Return to Factory Preset.

Communication Settings

Communication with the LD100 Line Doubler is accomplished by setting the following conditions: 9600, No Parity, 8 Data Bits and 1 Stop Bit. The factory BUAD rate is set at 9600, but rates of 1200, 2400 and 4800 are also available.

Baud Rate Selection

To change the RS-232 BAUD rate, remove the top cover of the LD100 Line Doubler. A 4 switch Dip switch is located on the front panel. Set the switches from the table shown below. If the BAUD rate is changed, the LD100 *MUST* be powered off and then on for the new BAUD rate to take effect.

DIP Switch Settings

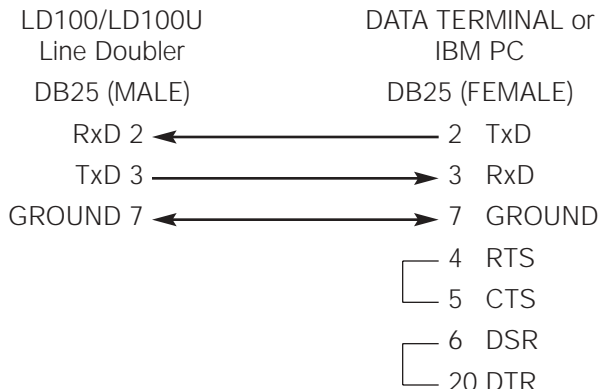
| Rate | 1 | 2 | 3 | 4 |
|-------|-----|-----|----|----|
| 1200 | ON | ON | ON | ON |
| 2400 | OFF | ON | ON | ON |
| 4800 | ON | OFF | ON | ON |
| *9600 | OFF | OFF | ON | ON |

* = Factory Preset

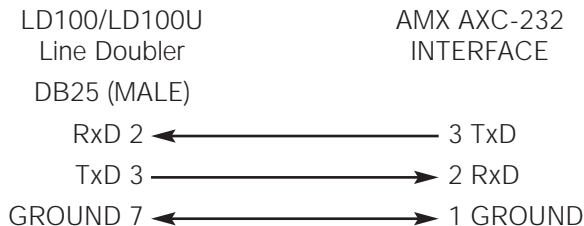
INSTALLATION

Interface to the LD100 Line Doubler is done by using a 3 wire interface. Interface schematics for the IBM-PC™, AMX™ and CRESTRON™ controllers are shown to the right.

CABLE SPECIFICATION: Computer Interface

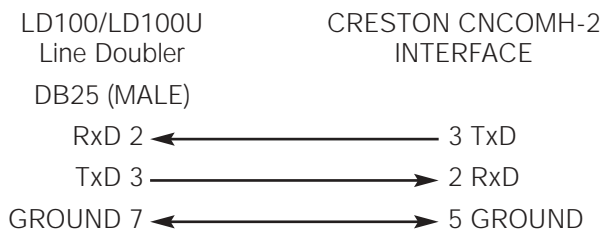


CABLE SPECIFICATION: AMX AXC-232 Interface



CABLE SPECIFICATION:

CRESTRON CNCOMH-2/CNMS Interface



Programming the LD100

Command Line

The LD100 is programmed by means of a "Command Line", which is an ASCII string of up to 255 characters that contains one or more individual instructions to the LD100. The Command Line offers the best compromise between manual operation via a data terminal and automatic control via a controller.

Command Line Entry

A Command Line can be entered in either upper or lower case by means of a data terminal or other controller. The Echo Mode determines the response of the LD100 to the incoming data stream. If the Echo Mode is ON (E1 command), the entered characters are echoed back to the host, and any message are sent in its entirety. If Echo Mode is OFF (E0 command), no characters are sent to host.

Command Syntax

Commands consist of a header followed by a keyword followed by additional parameters if needed. The header is used to identify the product, in the case the header is: LD100, . Keywords are single characters followed by integers (if needed). All commands must be separated by a comma ','. White spaces are ignored and may be used. All commands strings are terminated by a CARRIAGE RETURN (0x0d). Commands may be entered in any order as the user see fit.

Commands

Source Input Select Commands:

- V or v Select Video Input Mode
This command is a single character command.
- Y or y Select Y/C Input Mode
This command is a single character command.
- R or r Select RGB Input Mode
This command is a single character command.
- X or x Select Component (YUV) Mode
This command is a single character command.

Variable Adjustment Commands:

- B or b Adjust Brightness Level
This command is follow by an integer between 0(minimum) and 255(maximum). Example B1 or B12 or B123, ect.
- C or c Adjust Contrast Level
This command is follow by an integer between 0(minimum) and 255(maximum). Example C1 or C12 or C123, ect.
- K or k Adjust Color Level
This command is follow by an integer between 0(minimum) and 255(maximum). Example K1 or K12 or K123, ect.
- T or t Adjust Tint Phase
This command is follow by an integer between 1(minimum) and 255(maximum). If the command T0 is entered, the Auto-Tint mode is active where as numbers from 1 to 255 are used, the Auto-Tint Function is bypassed. Example T1 or T12 or T123, ect.
- N or n Adjust Noise Reduction Level
This command is follow by an integer between 0(minimum) and 255(maximum). Example N1 or N12 or N123, ect.
- D or d Adjust Detail Level
This command is follow by an integer between 0(minimum) and 255(maximum). Example D1 or D12 or D123, ect.

Switch Commands:

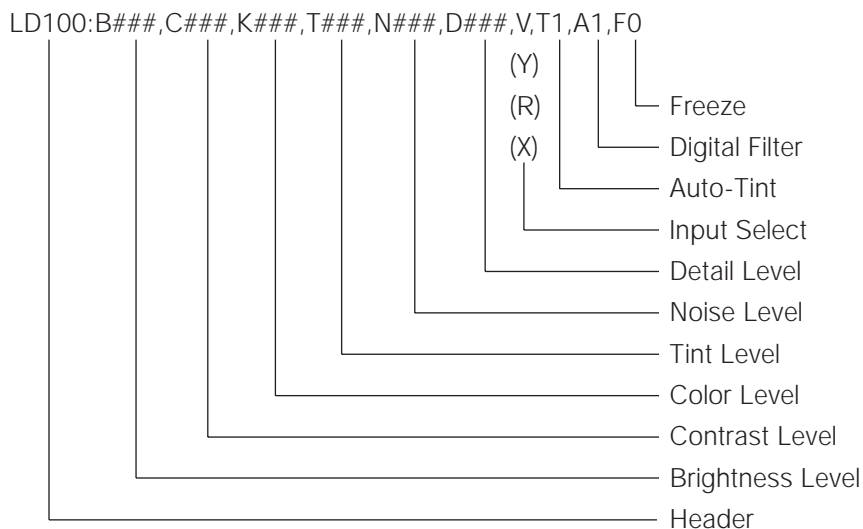
- A or a Digital Filter On / Off
This command is followed by an integer of 0 for off and 1 for on.
- F or f Freeze Mode On / Off
This command is followed by an integer of 0 for off and 1 for on.

Other Commands:

- E or e Echo Function
This command is followed by an integer of 0 for off and 1 for on.
- P or p This command is a single character command. This will return the LD100 to it's factory preset condition.

ST or st This command will return a string showing the current settings of the LD100.

Example:



HELP or help This command will return a list of commands used for the LD100 Line Doubler.

LD100 Local / Remote Operation

The LD100 stores all of its settings in a Non-volatile ram and will return to the last known settings when the unit is power up. The only exception is the Freeze function. The Freeze function will be set off during the power up cycle.

When a command is received via the RS-232, only those functions are placed in the remote mode. If a pot function is set via the remote, it can be returned back to local mode by adjusting that function on the front panel. This is accomplished by creating a window around that function when in remote mode. If that function is turned beyond the window setpoint, that function is returned to local mode and becomes active again.

Command String Examples:

Commands can be as simple as:

LD100,B150(CR)

to complex as

LD100,D240,N20,C150,B102,V,T0,A1,F0(CR)

Note (CR) = Carriage Return (0x0d) or ASCII 13

APPENDIX B

VGA Connector Pinout

| Pin | Function |
|-----|--------------------------------|
| 1 | Red Video |
| 2 | Green Video |
| 3 | Blue Video |
| 4 | Not Used |
| 5 | Ground |
| 6 | Red Return (Ground) |
| 7 | Green Return (Ground) |
| 8 | Blue Return (Ground) |
| 9 | Composite Sync |
| 10 | Composite Sync Return (Ground) |
| 11 | Not Used |
| 12 | Not Used |
| 13 | Horizontal Sync |
| 14 | Vertical Sync |
| 15 | Not Used |

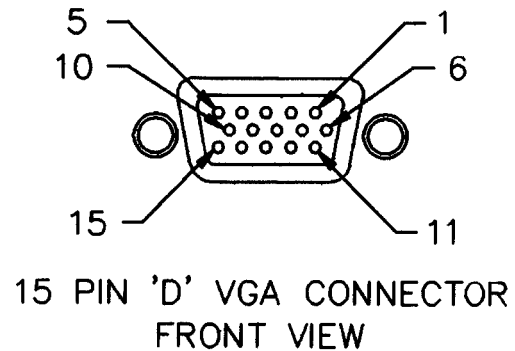


Figure 8

APPENDIX C

Cable Lengths and Distribution Amplifiers

To aid in achieving the best results from your installation, we suggest the following minimum standards for cable runs when an LD100 is used.

To preserve the video quality of the LD100, the signal path should be no more than -3db down at 25 MHz through a 75 ohm cable. Any distribution amplifier should have a bandwidth no less than -3db down at 25 MHz.

The following cable lengths are the maximum recommended continuous lengths of 75 ohm coax cable with BNC connectors on each end as well as 15 pin VGA cable (when using the VGA output).

| Cable Type | Maximum Length |
|--|----------------|
| Mini BNC cables, 75 ohm 1.15nS/Foot propagation | 100 Feet |
| RG-59/U type cable, 75 ohm | 150 Feet |
| 75 ohm precision video cable Belden 8281 | 200 Feet |
| 15 pin, high resolution VGA cables utilizing individual high resolution mini-coax cables for each signal from LD100 to monitor. | 25 Feet |

LD100 Specifications

| | |
|--|--|
| INPUT SIGNALS (NTSC) Video | 525 Line 2:1 Interlace 1Vp-p, Negative Sync 714mV Luminance |
| Y/C | Y/C (3.58) Non-Composite 700mVp-p Y 286mVp-p C (Burst) |
| RGB | 700mVp-p Non-Composite, 1Vp-p Composite |
| Component | Y(1V w/Sync), R-Y(714mV), B-Y(714mV) |
| Composite Sync | Negative, > 4Vp-p Composite |
| OUTPUT SIGNALS (NTSC) R, G, B | 525 Line Progressive Scan/1050 Line per Frame Non-composite, Positive, 714mVp-p |
| Vertical Sync | 59.94Hz, Negative, 4Vp-p, 75 Ohm |
| Horizontal Sync | 31.5KHz, Negative, 4Vp-p, 75 Ohm |
| Composite Sync | 31.5KHz/59.94Hz, Negative, 4Vp-p, 75 Ohm |
| VGA Standard | 15 Pin 'D' Connector, VGA Standard |
| LUMINANCE Input Conditions Output Conditions | Low-Pass Filter: -3db @ 11MHz Low-Pass Filter: -3db @ 22MHz |
| CHROMINANCE Input Conditions Output Conditions | Low-Pass Filter: -3db @ 6MHz Low-Pass Filter: -3db @ 12MHz |
| PROPAGATION DELAY | 1 Field + 2.5 Lines |
| POWER CONSUMPTION | 100-250 VAC, 50/60Hz, 60W, Auto Ranging |
| FUSE | 2 Amp, Slo-Blow AGC-2A |
| DIMENSIONS | 17"W* x 3.5"H x 21"D (43.1cm x 8.9cm x 53.3 cm) |
| WEIGHT | 22 lbs. (9.8Kg) |

NOTE: 625 lines 50Hz component or RGB signals are usable with the LD100. Outputs are identical to those of the LD100U in that mode.

*19" (48.26cm) with rack mount ears

Design and specifications are subject to change without notice.

LD100U Specifications

| | |
|--|--|
| INPUT SIGNALS (NTSC) Video | 525 Line 2:1 Interlace 1Vp-p, Negative Sync 714mV Luminance |
| Y/C | Y/C (3.58) Non-Composite 700mVp-p Y 286mVp-p C (Burst) |
| RGB | 700mVp-p Non-Composite, 1Vp-p Composite |
| YUV | Y(1V w/Sync), R-Y(714mV), B-Y(714mV) |
| Composite Sync | Negative, > 4Vp-p Composite |
| INPUT SIGNALS (PAL) Video | 625 Line 2:1 Interlace 1Vp-p, Negative Sync 700mV Luminance |
| Y/C | Y/C (4.43) Non-Composite 700mVp-p Y 286mVp-p C (Burst) |
| RGB | 700mVp-p Non-Composite, 1Vp-p Composite |
| YUV | Y(1V w/Sync), U(700mV), V(700mV) |
| Composite Sync | Negative, > 4Vp-p Composite |
| OUTPUT SIGNALS (NTSC) R, G, B | 525 Line Progressive Scan/1050 Line per Frame Non-composite, Positive, 714mVp-p |
| Vertical Sync | 59.94Hz, Negative, 4Vp-p, 75 Ohm |
| Horizontal Sync | 31.5KHz, Negative, 4Vp-p, 75 Ohm |
| Composite Sync | 31.5KHz/59.94Hz, Negative, 4Vp-p, 75 Ohm |
| VGA Standard | 15 Pin 'D' Connector, VGA Standard |
| OUTPUT SIGNALS (PAL) R, G, B | 625 Line Progressive Scan/1250 Line per Frame Non-composite, Positive, 700mVp-p |
| Vertical Sync | 50Hz, Negative, 4Vp-p, 75 Ohm |
| Horizontal Sync | 31.2KHz, Negative, 4Vp-p, 75 Ohm |
| Composite Sync | 31.2KHz/50Hz, Negative, 4Vp-p, 75 Ohm |
| VGA Standard | 15 Pin 'D' Connector, VGA Standard |
| LUMINANCE Input Conditions Output Conditions | Low-Pass Filter: -3db @ 11MHz Low-Pass Filter: -3db @ 22MHz |
| CHROMINANCE Input Conditions Output Conditions | Low-Pass Filter: -3db @ 6MHz Low-Pass Filter: -3db @ 12MHz |
| PROPAGATION DELAY | 1 Field + 2.5 Lines (NTSC) 1 Field +3.5 Lines (PAL) |
| POWER CONSUMPTION | 100-250 VAC, 50/60Hz, 60W, Auto Ranging |
| FUSE | 2 Amp, Slo-Blow AGC-2A |
| DIMENSIONS | 17"W* x 3.5"H x 21"D (43.1cm x 8.9cm x 53.3 cm) |
| WEIGHT | 22 lbs. (9.8Kg) |

*19" (48.26cm) with rack mount ears

Design and specifications are subject to change without notice.

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