PROTON-LVDS

System Manual

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2 Revision history

Revision	Date	Autor / Editor	Issue
0.10	2009-04-02	Ramiro Ibanez	First draft
1.00	2010-20-01	Ramiro Ibanez	System Manual

3 References

ID	Document	Company		
[1]	AD9887A dual DVI RGB receiver data sheet	Analog Devices		
[2]	DS90UR241 and DS90UR124 Datasheet (www.national.com)	National Semiconductor	-	-
[3]	Inova INAP125xx Preliminary Data Sheet (APIX)	Inova Semiconductor	-	2006-04-12 Rev. 0.9
[4]	TFP410-EP DVI transmitter data sheet	Texas instruments		
[5]	THS8133B RGB digital to analog converter data sheet	Texas instruments		
[6]	ADV1780 analog video decoder	Analog devices		

4 Introduction

PROTON-LVDS is a video gateway/generator/analyzer platform composed by PROTON-LVDS hardware and PROTON-LVDS PC windows application.

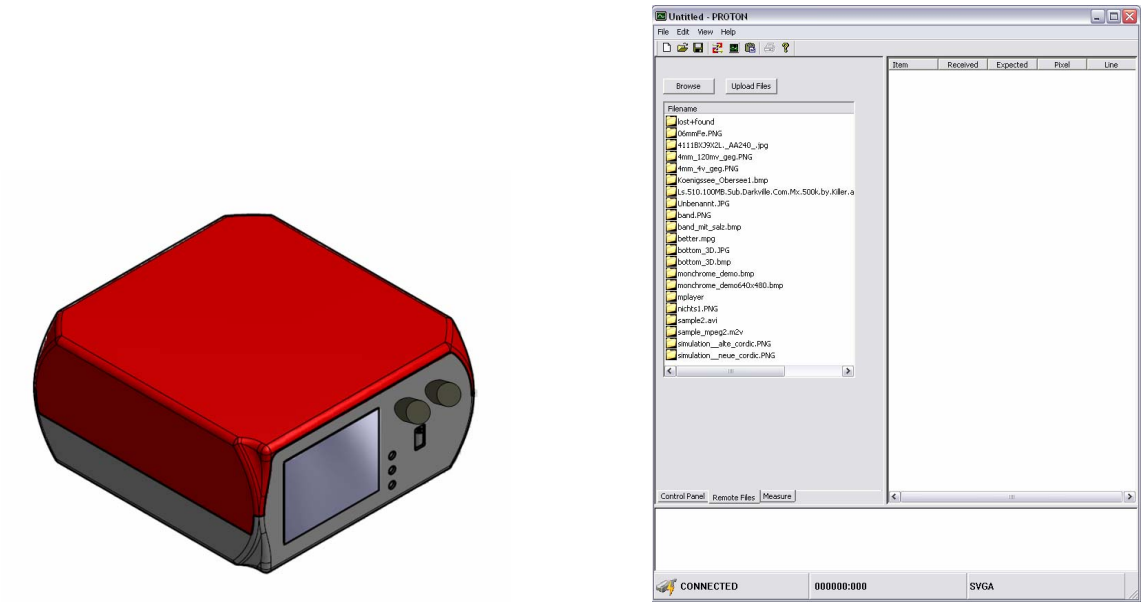


Figure 4.1. *PROTON-LVDS.*

The user can control PROTON-LVDS hardware through the PC application or via embedded graphical interface using the rotary encoders on the front panel of the system housing.

System features

- 2 wire LVDS National Semiconductors video source and sink possibilities DS90UR241/DS90UR124. Configuration of LVDS transceivers is user programmable. Digital pre-emphasis current control.
- INOVA APIX interface video source and sink possibilities INAP124T24/INAP125R24. Configuration of LVDS transceivers is user programmable. Digital pre-emphasis, swing and nominal current control.
- DVI single link input (up to 165MHz pixel clock). DVI single link output.
- Standard analog RGB input/output (VESA compliant).
- Built-in video decoder for composite, S-Video and components (YUV) analog video

input.

- Ethernet, USB host, RS232 and CAN bus connectivity.
- Embedded graphical interface and PC software for system configuration (upload/download pictures, videos, scripts and measurement files).
- Real Time video gateway with user programmable retiming. INOVA to INOVA , NATIONAL to INOVA, INOVA to NATIONAL, NATIONAL to NATIONAL, DVI to LVDS, LVDS to DVI, LVDS to RGB, analog video to LVDS, RGB to LVDS. On different resolution, the user selects the output picture area with a programmable sliding window.
- FPGA based video timing generator driven by a programmable pixel clock source adjustable in fine steps (100KHz) within the range from 1MHz to 150MHz. Independent pixel clock for every LVDS channel. Embedded timing display data base with up to 128 different displays specs. Embedded menu allows the user to assign timings for every video channel.
- Software programmable pin assignment on parallel input/output LVDS video data (RGB) and sync signals.
- 31 different frame buffers on SDRAM memory of 2048x2048 pixels with 24 bit color depth. Instantaneous frame buffer swapping on a single video channel.
- INOVA, NATIONAL, and DVI/RGB channels linked or completely independent, different timing and pixel clock (user programmable).
- 2GB of non volatile memory for storing pictures in BMP and PNG format. Fast DMA transfer between non-volatile and frame buffers. User programmable file assignment on every frame buffer.
- Selectable reference pattern via PC GUI or embedded menu.
- Programmable CAN generator with up to 16 different ID’s. Cyclic messages with 1ms granularity, minimum cycle of 25 ms. CAN bus trace/logger functionality
- System startup files stored in non-volatile memory configure the system at boot time for ready to use measurement sessions.

- PC WINDOWS based application configures start up files and display measurement and status results.
- The System is targeted for being used in room temperature range (10°C-35°C).
- The System is powered from DC power supply of 12 V nominal (9-20V). The power consumption is 24 Watts max.

Next table shows the possibilities for the user to access the system features.

Feature	PC software	Embedded interface (Stand Alone)
LVDS chip set configuration	Possible	Possible
Video timing configuration	Every timing parameter for a given video channel can be programmed by the user.	User selects a timing setup for every video channel from a database of 128 different timing specifications created by the PC software.
Display Data base edition	Possible	Not possible
RGB assignment of the LVDS channels	Possible	Not possible.
Nonvolatile configuration files management	Possible	Possible
Update nonvolatile image pattern memory	Possible	Not possible
Modify video channel parameters	Possible	Possible
Modify video routing setup	Possible	Possible
Pattern assignment to frame buffer	Possible	Possible
Display of timing info on input video channel	Not possible	Possible
Setup of Low level parameters of standard video interface chips	Possible	Not possible

Feature	PC software	Embedded interface (Stand Alone)
(Video decoder, RGB and DVI inputs)		
Automatic video Gateway	Not possible	Possible
CAN bus message setup	Possible	Possible (restricted to few parameters per message).
CAN bus trace functionality	Not possible	Possible
CAN bus play list copy functionality	Not possible	Possible
Picture Loop Setup	Possible	Possible

4.1 PROTON-LVDS Architecture

All image data output on the video channels of the PROTON-LVDS system is stored temporarily in a memory area divided in two memory blocks; they are memory block A and memory block B. Every block is divided in 31 different frame buffers. Each block (31 frame buffers) is accessible by a set of video channels and the microcontroller.

- *Memory block A* is accessible by the NSC (National semiconductor) video channel, INOVA video channel, the Gateway A channel and the microcontroller. All of them can write or read to or from the whole block (all 31 frame buffers).
- *Frame buffer memory block B* is accessible by the DVI, RGB and analog video channels, the Gateway B channel and the microcontroller. All of them can write or read to or from the whole block (all 31 frame buffers).

Next figure sketches the principle of PROTON-LVDS architecture.

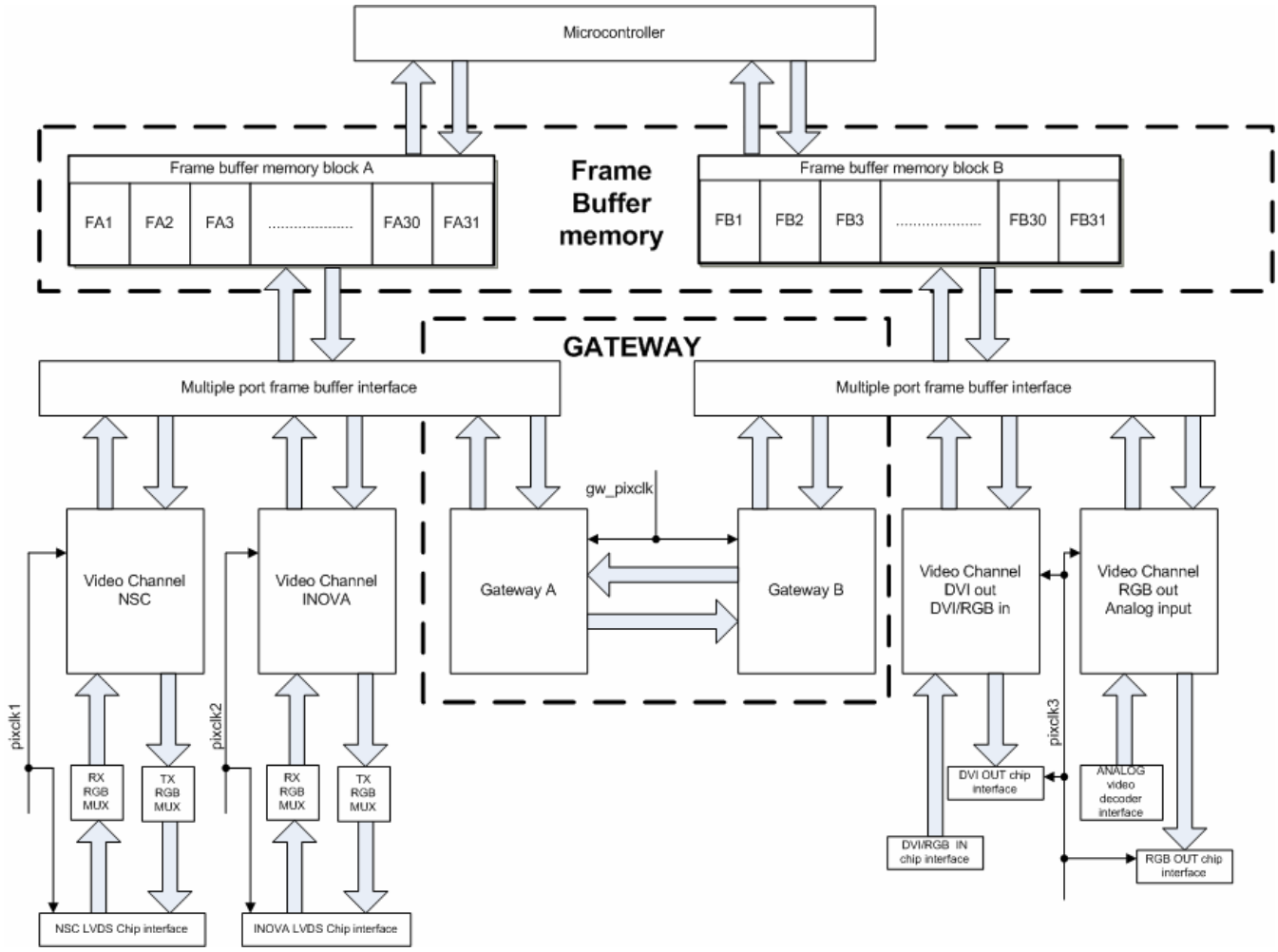


Figure 4.2. *PROTON-LVDS architecture.*

A video channel block can be enabled to read or write directly to or from a given frame buffer on its corresponding memory area. The access to the memory area by the video channels is concurrent, so all video channels are allowed to read or write data in real time with the limitation of the physical bandwidth of the memory which is approximately 4Gbps. This information is important when enabling all the channels. If the user needs a stable picture, must avoid data rates bigger than the supported by memory itself. *Enabling 2 channels for reading and writing at 1Gbps would reach the limit of the memory bandwidth*.

There are three programmable pixel clocks in the system. The pixel clock signals programming range is 1MHz to 150 MHz in steps of 100KHz. The signals are:

- pixclk1: assigned to the video channel controlling NSC LVDS transmitter chip.
- pixclk2: assigned to the video channel controlling INOVA LVDS transmitter chip.

- pixclk3: assigned to the video channels controlling DVI out and RGB out. Attention changing the timing of the DVI output affects the RGB output timing (sn the other way around) if both don't use the same pixel clock.

4.2 PROTON-LVDS basic concepts

This section limits the meaning of some of the terms used along this document and in the PROTONV-LVDS system; both PC software and embedded graphical interface. The definitions of these concepts are only related to PROTON-LVDS system.

4.2.1 Frame buffer memory Block

A frame buffer memory block is a set of 31 frame buffers. There are two blocks is the system. Each block has assigned a set of video channels.

4.2.2 Frame buffer

The frame buffer in PROTON-LVDS system is a memory area where a given picture/pattern is stored temporarily. A frame buffer belongs to a frame buffer memory block. There are two memory blocks in the system with 31 frame buffers each. The size of a frame buffer is approximately 16MB (1023*1204*16bytes) and keeps a pixel value with 24 bits, 8 bits for RED, 8 bits for GREEN and 8 bits for BLUE color component.

A frame buffer can be read or written by any video channel assigned to its corresponding memory block. The microcontroller of the system can access to every frame buffer in both memory blocks.

4.2.3 Video channel

A video channel is a programmable video generator/grabber unit. The generator and grabber functionality may run at the same time. As a generator it has assigned a frame buffer (read buffer), a timing parameter set (display type), a horizontal and vertical frame buffer offset for reading, window size and a programmable background color (RGB). As a grabber it has assigned a frame buffer for writing (write buffer) and a horizontal and vertical frame buffer offset for writing. There are 6 video channels in PROTON-LVDS system:

- **National**. Assigned to LVDS receiver and transmitter. DS90UR241/DS90UR124 chipset.

- **INOVA**. Assigned to LVDS receiver and transmitter. INAP124T24/INAP125R24 chipset.
- **DVI-RGB**. Assigned to a DVI/RGB receiver and to DVI transmitter.
- **ANALOG-RGB**. Assigned to an analog video decoder and to a RGB transmitter (analog output).
- **Gateway A**. Sends data from frame buffer memory block A to frame buffer memory block B. Writes data coming from frame buffer memory block B to frame buffer memory block A.
- **Gateway B**. Sends data from frame buffer memory block B to frame buffer memory block A. Writes data coming from frame buffer memory block A to frame buffer memory block B.

4.2.4 Display database / Display types

A display database in PROTON-LVDS is a set of 128 programmable timing specifications corresponding to 128 display types. A timing specification or display type is a list of timing parameters as follows:

Display type			
Parameter	*Units*	*Range*	*Resolution*
pixel clock	Hz	1MHz-150MHz	+-100KHz
Horizontal sync pulse	pixel clocks	1-2048	+/-1
Horizontal sync period	pixel clocks	1-2048	+/-1
Horizontal Back porch	pixel clocks	1-2048	+/-1
Horizontal Front porch	pixel clocks	1-2048	+/-1
Horizontal active time	pixel clocks	1-2048	+/-1
Vertical sync pulse	lines	1-2048	+/-1
Vertical sync period	lines	1-2048	+/-1
Vertical Back porch	lines	1-2048	+/-1
Vertical Front porch	lines	1-2048	+/-1
Vertical active time	lines	1-2048	+/-1
Phase Horizontal and vertical Sync	pixel clocks	-10-10	+/-1
Sync polarity	--	High-Low	--
Enable mode	--	High-Low	--

4.2.5 Patterns

A pattern is an image file in BMP or PNG format which are supported by PROTON-LVDS system.

4.2.6 Configuration Files (*.som)

A binary file containing the configuration parameters needed for using PROTON-LVDS. They can be stored in the remote hardware or in the host PC. They contain the following data fields:

Data field	Description
Display specifications	A data base of 128 different display types.
Video channel timing	Timing configuration for every video channel of the system.
Routing setup	Video channel setup information
INOVA LVDS chip configuration	Set up for both INAP124T24 and INAP125R24 INOVA LVDS chips.
National LVDS chip configuration	Set up for both DS90UR241 and DS90UR124 National semiconductors LVDS chips.
Analog video decoder setup	Internal register values for the ADV7180 analog video decoder.
RGB/DVI video receiver/ADC	Internal register values for the AD9887A video ADC and DVI receiver.
DVI transmitter setup	Internal register values for the TFP410 DVI transmitter chip
RGB assignment	RGB assignment of INOVA and National semiconductors video channels (RX and TX).
Frame Buffer Info	Frame buffer setup containing the file name assigned to it.
CAN bus setup	Parameters assigned to the CAN bus on PROTON-LVDS. 16 different CAN messages including ID, data field, DLC, remote and extended flags, period and enable flag.
Script setup	Parameters configuring the picture loop script and automatic picture load process

5 PROTON-LVDS Hardware

PROTON-LVDS is composed by the following hardware items:

- PROTON backplane with IO and standard video connectivity.
- 32 bit microcontroller module running embedded Linux.
- A CPLD module buffers the microcontroller system bus.
- Two FPGA modules.
- Two SDRAM modules.
- One IO module with the National Semiconductor chipset DS90UR241/DS90UR124.
- One IO module with INOVA chipset INAP124T24/INAP125R24.
- One power and isolation module.
- One 320x240 RGB LCD.

On one side of the system housing the generic/standard IO and power connectors are found as sketched in the following picture:

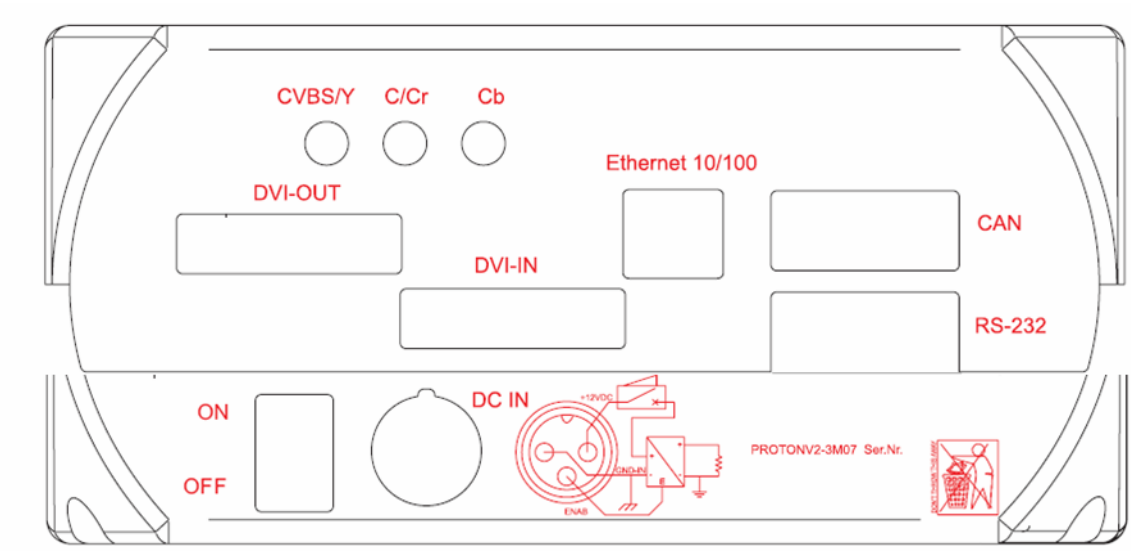


Figure 5.1. *PROTON-LVDS side view.*

The system is powered with a nominal voltage of 12v DC Voltage in the range between 9 and 24 volts and the maximum power consumption is 24Watts. On the system housing, the three pin round connector gets the power supply for the system with the following pin assignment:

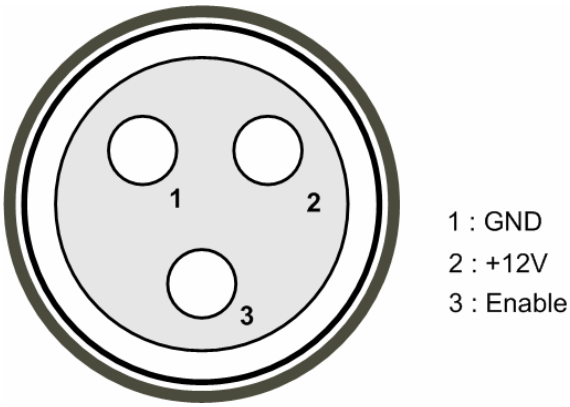


Figure 5.2 *PROTON-LVDS power supply connector.*

The pin 3 is the power supply enable signal. Connecting this pin to ground disables the power supply. It can be used for remote power supply control.

The DVI connectors of the system follow the DVI-I single Link configuration, where only one TMDS video channel is present together with the RGB analog and sync signals. Next figure shows the pin assignment on the PROTON-LVDS DVI connectors (input and output).

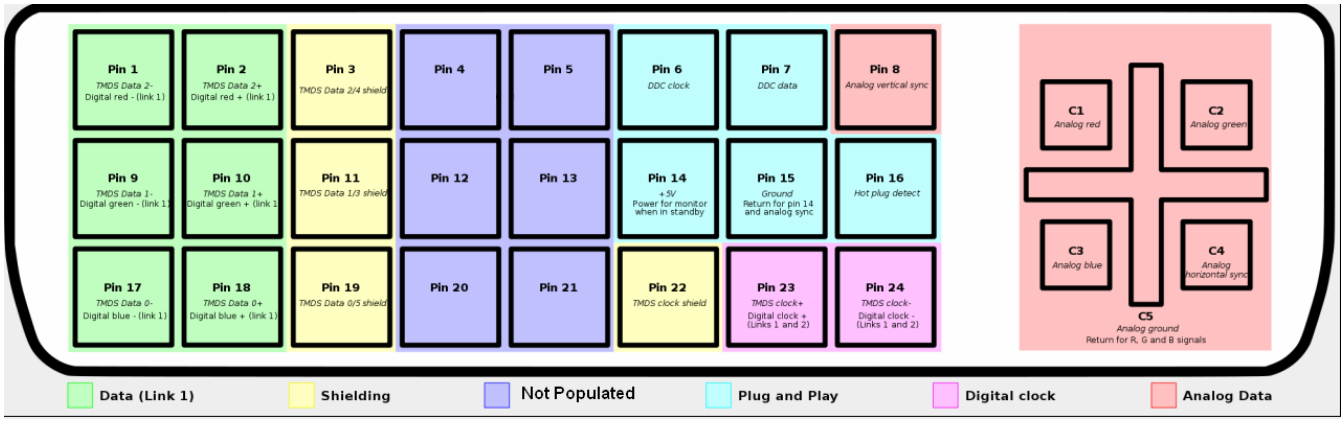


Figure 5.3 *PROTON-LVDS DVI-I Single Link (input and output).*

The analog video input connectors have different functions depending on the analog video format used. The analog video decoder included in PROTON-LVDS recognizes composite, separate video and components analog video formats.

Connector	Video Format		
	Composite	S-Video	Components
CVBS/Y	Video (Y+Cr+Cb)	Luminance	Luminance
C/Cr	Not used	Chroma (Cr+Cb)	Chroma R
Cb	Not used	Not used	Chroma B

The CAN bus DSub-9 connector pin assignment is enumerated in the following table:

Pin	Signal
1	+5V power supply output (max 100mA)
2	CANL
3	GND
4	Not populated
5	GND
6	GND
7	CANH
8	Not populated
9	Not populated

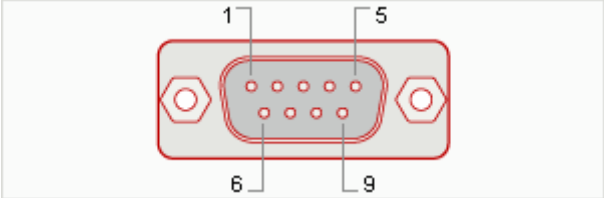


Figure 5.4. *PROTON-LVDS CAN bus DSub9 connector.*

An internal 1KOhm resistor between CANH and CANL signals makes a soft bus termination.

The RS232 DSub-9 socket pin assignment is enumerated in the following table:

Pin	Signal
1	Not populated
2	RS_TXD (output)
3	RS_RXD (input)
4	Not populated
5	GND
6	Not populated
7	Not populated
8	Not populated
9	Not populated

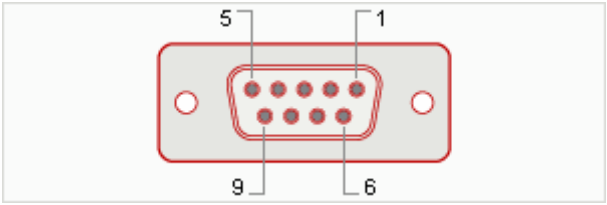


Figure 5.5. *PROTON-LVDS RS232 DSub9 socket.*

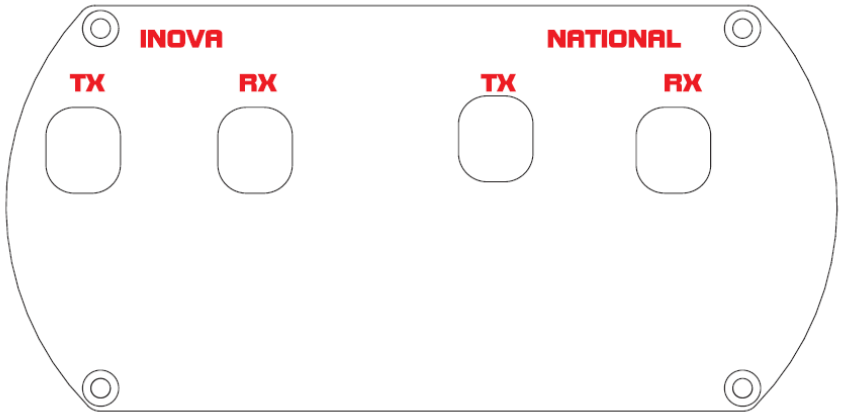


Figure 5.6. *PROTON-LVDS back plate.*

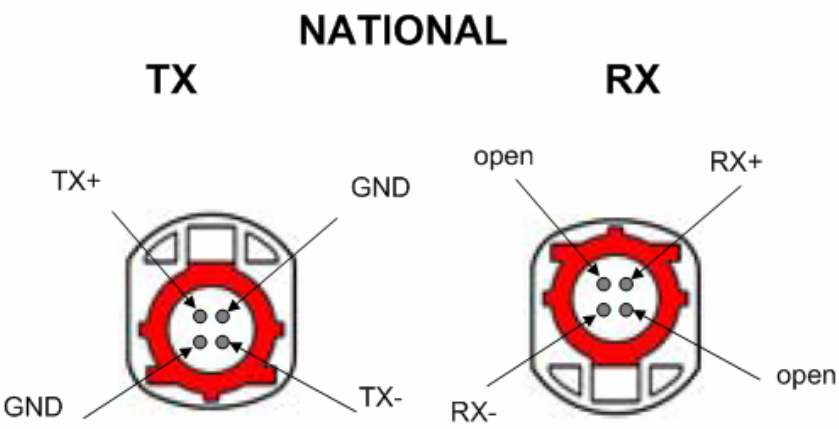


Figure 5.7. *PROTON-LVDS National Semiconductors LVDS Rosenberger connector pin assignment (front view).*

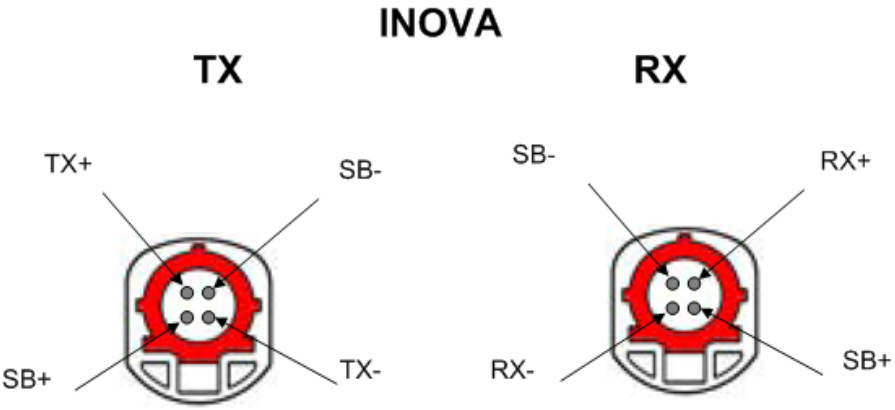


Figure 5.8. *PROTON-LVDS INOVA LVDS Rosenberger connector pin assignment (front view).*

The front side of PROTON-LVDS contains the embedded user interface elements.

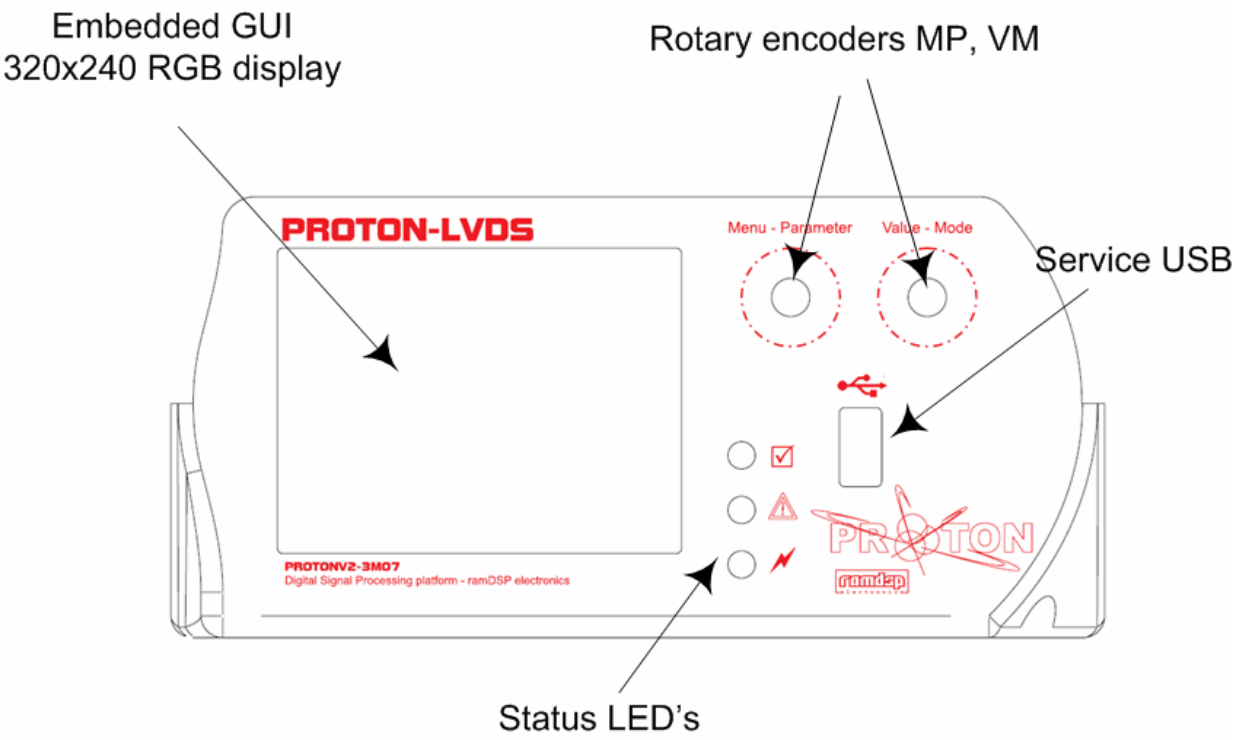


Figure 5.3. *PROTON-LVDS front view.*

6 PROTON-LVDS PC Software

PROTON-LVDS PC GUI provides the basic functionality to configure PROTON-LVDS hardware, download patterns and configuration files. The communication to remote hardware is executed via Ethernet link.

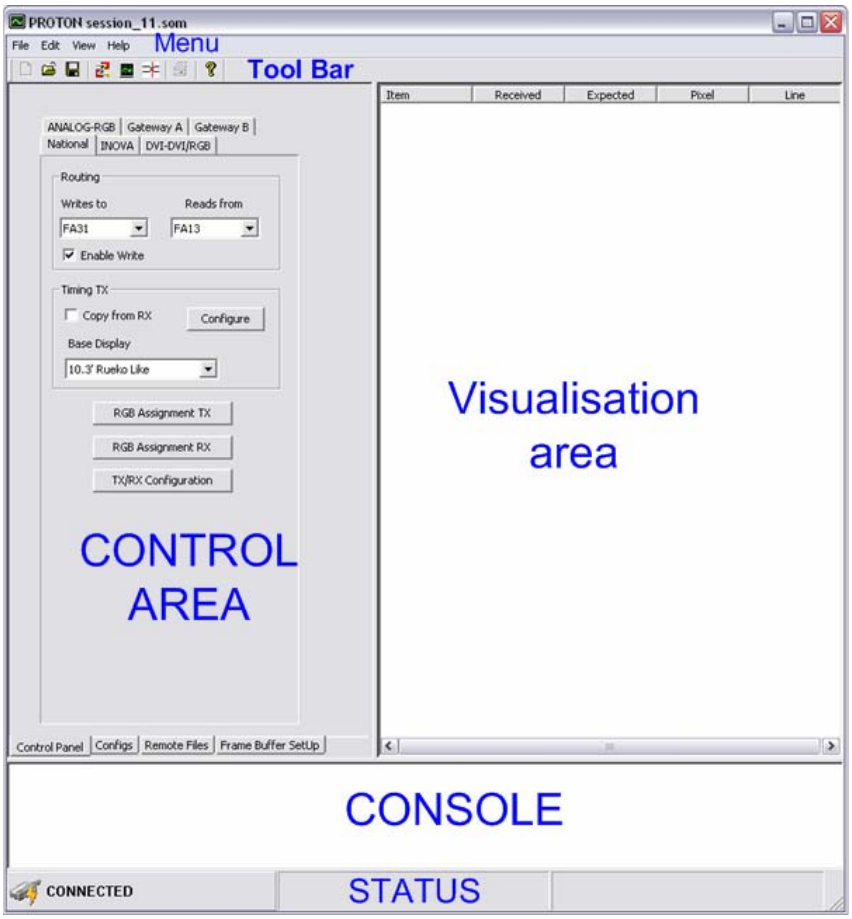


Figure 6.1 *PROTON-LVDS PC software layout*

The user interface is divided in several functional areas, they are:

- Menu.
- Tool Bar.
- Control Area.
- Visualization area.
- Console.
- Status Bar.

6.1 Menu

- *File.*
  - Open. Opens a PROTON-LVDS configuration file from the hard disk in the PC host and initializes all dialog elements in the graphical user interface.
  - Save. Saves the present configuration to a file. It prompts always for a file name.
  - Exit. Exits the application.
- *View.*
  - Toolbar. Hides, shows the tool bar.
  - Status Bar. Hides, shows the status bar.
  - Split. Moves the vertical splitter on the graphical user interface.
- *Help.*
  - About PROTON. Shows version information of PC software, and firmware of remote hardware when connected over ethernet.

6.2 Tool Bar

As shown in the following figure, 6 elements form the tool bar of PROTON-LVDS PC software.

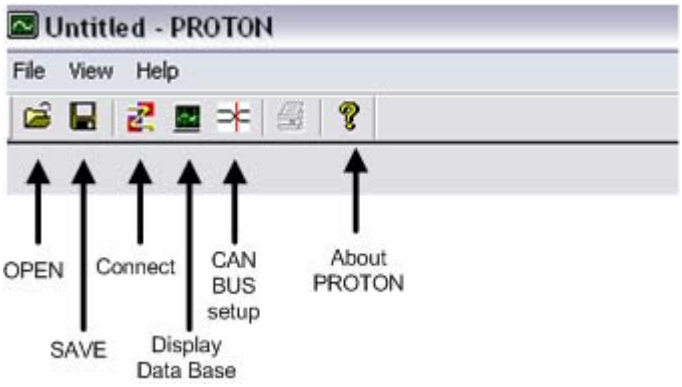


Figure 6.2 *PROTON-LVDS PC software tool bar*

6.2.1 Open

Opens a PROTON-LVDS configuration file from the hard disk in the PC host and initializes all dialog elements in the graphical user interface.

6.2.2 Save

Saves the present configuration to a file. It prompts always for a file name.

6.2.3 Connect

After pressing the connect button of the tool bar an IP address dialog pops up. The user must type in the correct IP address of the PROTON-LVDS hardware and press the OK button.

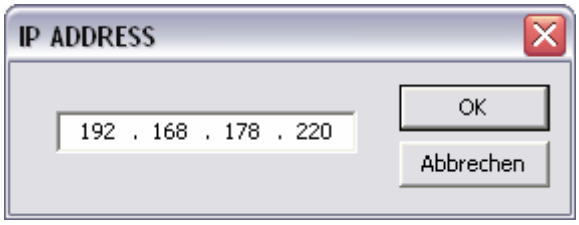


Figure 6.3. *IP address dialog*

After the connection has been established, the status bar message area will be updated. If there is a problem in the Ethernet connection or the IP address is wrongly configured an error dialog appears.

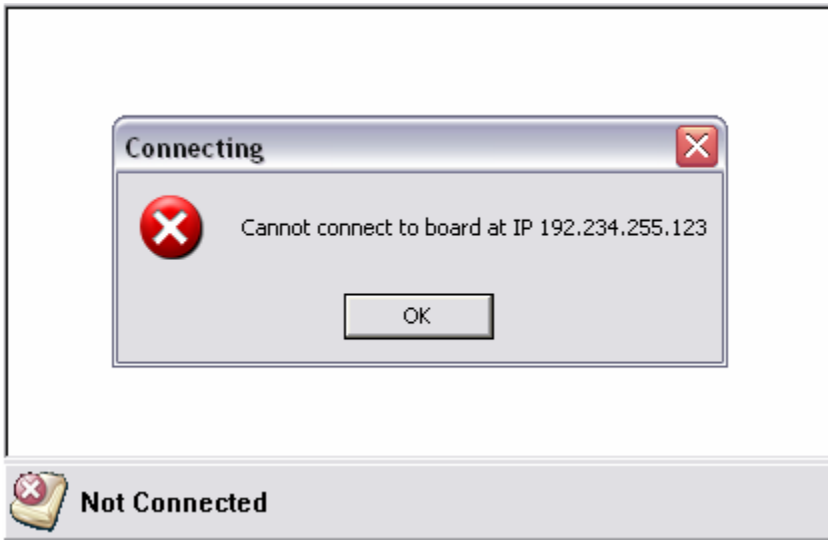


Figure 6.4. *Error dialog during unreachable IP address*

On Success, the system updates the tool bar with the ICON and message of CONNECTED, and the window is named after the configuration file used by the PROTON-LVDS at the moment of connection (see figure 6.5 as example).

The first task executed by the software after connecting to the hardware, is to download the configuration data being used, so after the connection hardware and software are synchronized. The user must be aware that the embedded user interface is still functional when PC software is connected, that means that changing the parameters of PROTON-LVDS

using the embedded interface while the PC software is connected causes loosing the synchronization, i.e. remote hardware and PC software have different configs.

A second issue for the user when connecting to the remote hardware is the possibility of loosing the configuration data stored in the graphical user interface elements of the PC software. Take into account is that when the user connects to the hardware, the configuration present in the PC software is lost, simply overwritten by the remote hardware configuration. To avoid this, save first the data to the PC host hard disk.

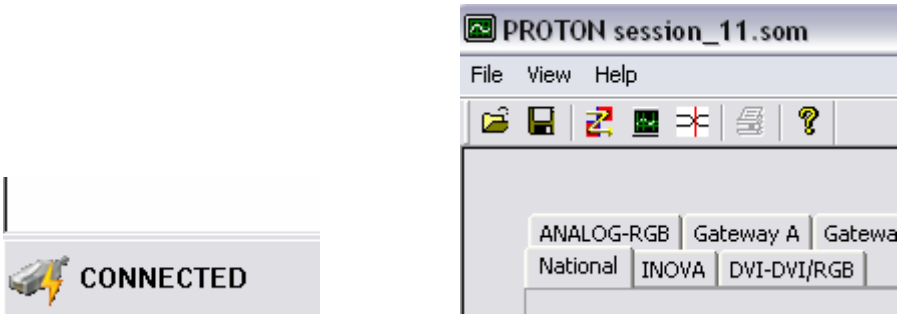


Figure 6.5. *Successfully connected to PROTON-LVDS*

6.2.4 Display data Base dialog

The display data base button on the tool bar opens the dialog that allows editing and visualizing all 128 display specifications present in the active configuration.

Every display specification has the following editable parameters:

Display type				
Parameter		***Units***	***Range***	***Resolution***
pixel clock,	fCLK	Hz	1MHz-150MHz	+-100KHz
Horizontal sync pulse,	tWHL	pixel clocks	1-2048	+/-1
Horizontal Back porch,	tHBP	pixel clocks	1-2048	+/-1
Horizontal Front porch,	tHFP	pixel clocks	1-2048	+/-1
Enable time	tEnab	pixel clocks	1-2048	+/-1
Horizontal active time,	tHA	pixel clocks	1-2048	+/-1
Vertical sync pulse,	tWVL	lines	1-2048	+/-1
Vertical Back porch,	tVBP	lines	1-2048	+/-1
Vertical Front porch,	tVFP	lines	1-2048	+/-1
Vertical active time,	tVA	lines	1-2048	+/-1
Phase Horizontal and vertical Sync	tvH	pixel clocks	-10-10	+/-1
Sync polarity		--	High-Low	--
Enable mode		--	High-Low	--

The definition of the parameters enumerated in the table above is implicit in the following two figures.

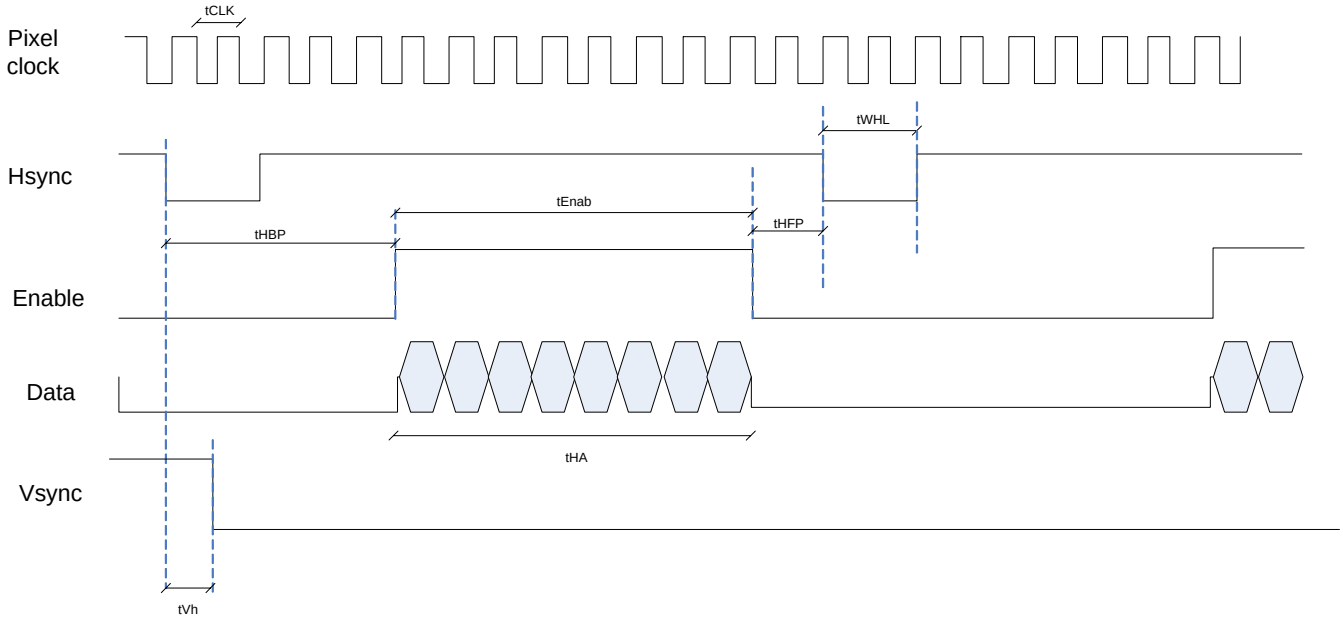


Figure 6.6. *Horizontal timing definition*

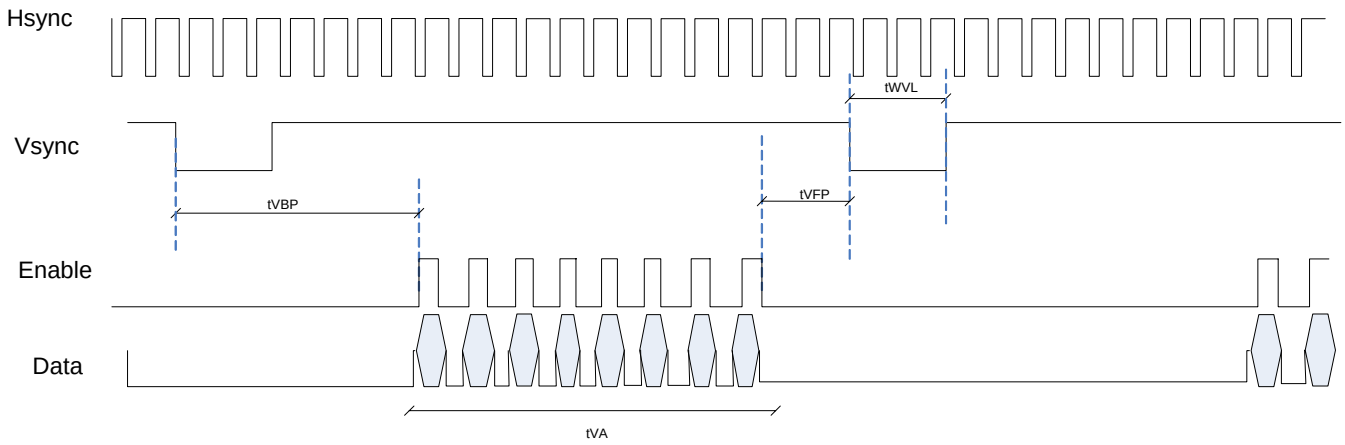


Figure 6.7. *Vertical timing definition*

The display data base has 128 positions enumerated from 0 to 127. The first 10 positions are read only and they can be used to generate display type derivatives. The process of generating a display type is follows 5 steps:

- Load a base display type selecting one type from the combo box “Base Display” in the dialog.

- Edit the value fields to fit the desired specifications.
- Enter a name for the new display type in the “Display name” edit box.
- Select data base position where to save the display type. The data base position is selected by scrolling the combo box “Save to DB position”. A position between 10 and 127 can be selected.
- Press “Save to DB” button. After pressing this button the position selected in the data base will be overwritten. The display data base in the PC software contains now the new display type. To send the data base to the remote hardware press OK, the dialog will close and the data base elements sent to the remote hardware.

Next figure show the display data base dialog.

Figure 6.8. *Display Data base dialog*

6.2.5 CAN Bus set up dialog

The **CAN Bus SetUp** dialog allows the user to configure 16 different CAN messages to be sent cyclically by the CAN controller integrated in PROTON-LVDS. As shown in the following figure the dialog contains independent edit fields and check buttons for every message distributed in rows and six different columns for their editable properties.

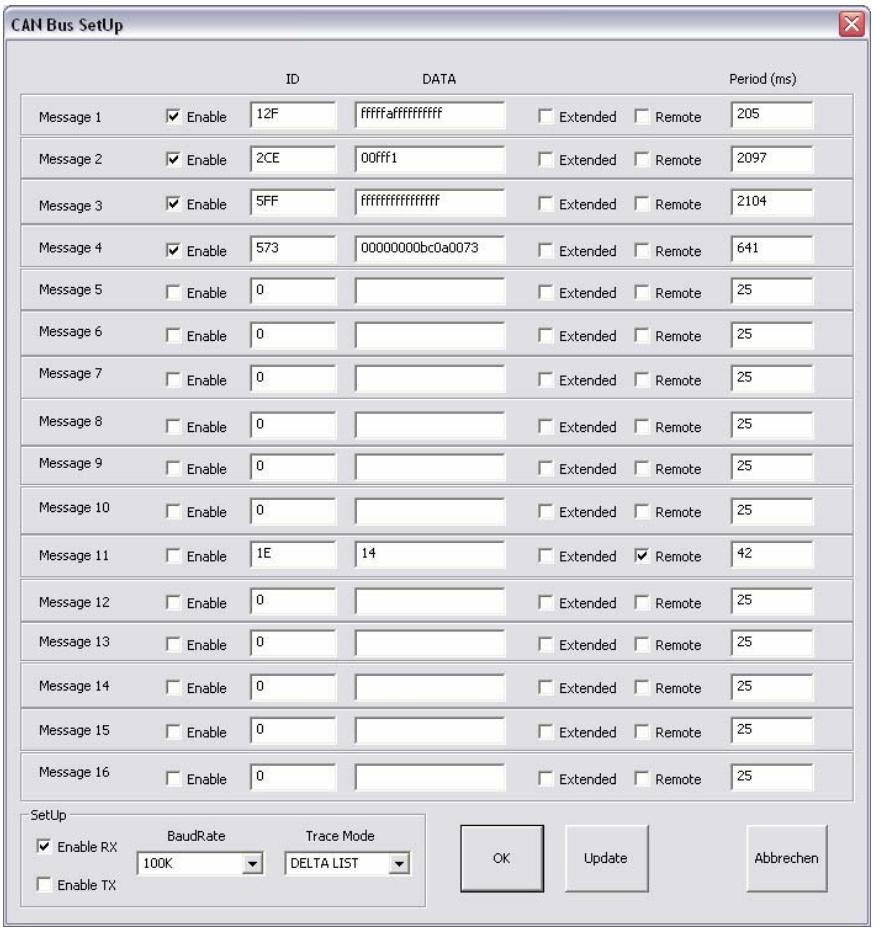


Figure 6.9. *CAN Bus SetUp dialog.*

- **Enable Check Button**. If checked and the CAN transmitter loop is enabled, the selected message will be sent accordingly to the programmed properties.
- **ID Edit field**. The ID used on the transmission of the CAN message. Maximum programmable length of 28 bits (7 ASCI characters) coded in hexadecimal.
- **DATA Edit field**. The data transmitted within the CAN frame. Maximum programmable length is 64 bits (16 ASCII characters) coded in hexadecimal. The length of the string sets the DLC. As an example, typing the value FFA0129, would lead to a DLC of 4, and

a data field data[0]=256, data[1]=160, data[2]=18 and data[3]=144 (0x9 is taken as most significant bits of the byte and is padded with four zeroes, resulting in 0x90). For a DLC of 0 erase the contents of the corresponding data edit field.

- **Extended check button**. Extended CAN message flag, if checked the flag is 1, if unchecked the flag is reset to 0.
- **Remote check button**. Remote CAN message flag, if checked the flag is 1, if unchecked the flag is reset to 0.
- **Period (ms) Edit field**. Sets the period used by the transmitter routing to send the corresponding message in the row. The minimum value is 25 ms, the maximum value is 9999 ms.

In the lower left corner of the dialog, the general settings for the CAN bus functional block can be configured, they are:

- **Enable RX check button**. If checked, PROTON-LVDS CAN bus controller stores in a ring buffer of 1024 elements the CAN frames present in the bus.
- **Enable TX check button**. If checked PROTON-LVDS CAN bus controller sends cyclically the messages configured by the user in the table above.
- **Baudrate ComboBox**. A baud rate can be selected within the values 10K, 20K, 50K, 100K, 125K, 250K, 500K, 800K and 1000K. Other values are not possible in the present version of the system.
- **Trace Mode ComboBox**. With this dialog item, the user can select the mode the CAN receiver keeps the CAN messages in the ring buffer. If set to *delta list*, the receiver stores the CAN frames accordingly to the CAN frame ID, i.e. one buffer position per ID and calculates the time between messages. If set to full list, the receiver stores the CAN frames in the buffer in a ring buffer fashion storing an absolute time stamp. The maximum number of CAN messages stored in the list is 1024.

6.3 Control Area.

The control area embeds different dialogs using a tab control element. On the top level there are 4 dialogs, some of the dialogs embed more sub-dialogs themselves. The hierarchy is as follows:

- *Remote Files*. Browse, download and upload image files in BMP and PNG format from/to the remote hardware via ftp.
- *Configs*. Browse, download and upload system configuration files in SOM format from/to the remote hardware via ftp.
- *Frame Buffer Set up*. This dialog controls the configuration assigned to memory scripts and keeps track of which image file is assigned to which frame buffer in the remote system. The frame buffers are grouped in 4 different tabs.
    - FA1-FA16
    - FA17-FA31
    - FB1-FB16
    - FB17-FB31
- *Control Panel*. This set of dialogs controls the video channel configuration. One dialog for every video channel. Read Buffer, Write buffer, write enable, timing specifications and integrated circuit parameters.
    - National
    - Inova
    - DVI-RGB
    - ANALOG-RGB
    - Gateway A
    - Gateway B

6.3.1 Remote Files Control Dialog

Through this dialog the user can browse, upload, erase and download image files from and to the non volatile memory of PROTON-LVDS. The supported image file formats are windows bitmap (*.BMP) and portable network graphics (*.PNG).

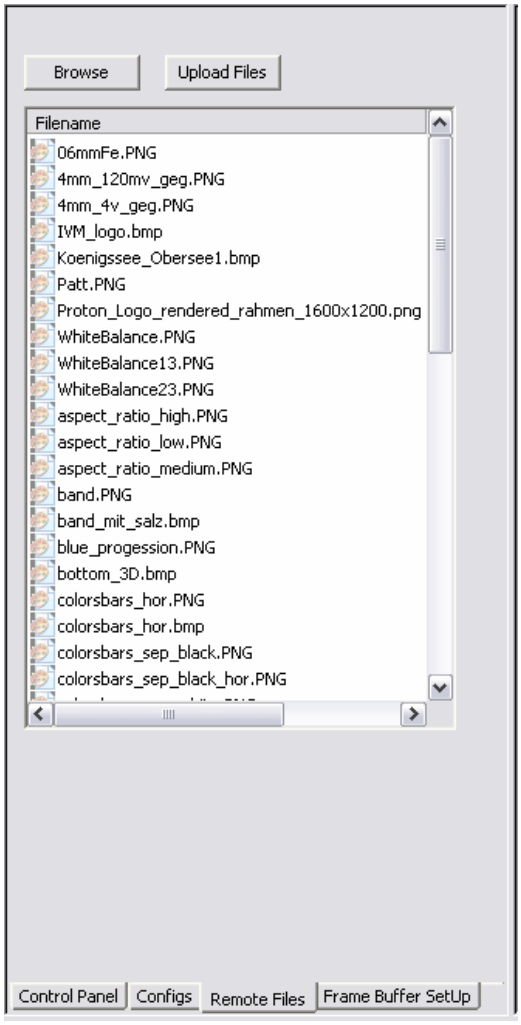


Figure 6.10. *Remote files control dialog (image files).*

- **Browse Button**. Lists the image files in the nonvolatile memory of PROTON-LVDS.
- **Upload Files Button**. Opens a file selection dialog where the user can browse for image files (BMP and PNG) in the PC host file system.

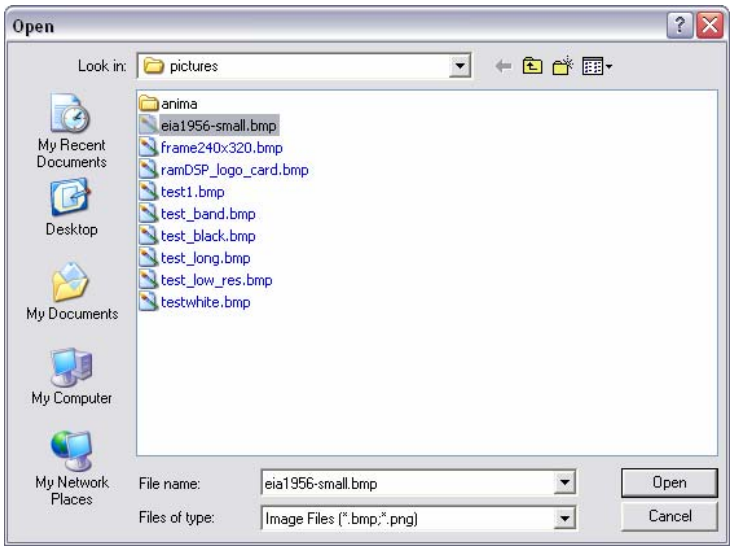


Figure 6.11. *Open image file dialog (image files).*

Once a file has been selected in the dialog, press Open button and a progress bar appears showing the transfer rate and the remaining time. Upon completion the new uploaded file will be also displayed within the file list in the main *"Remote files"* dialog.

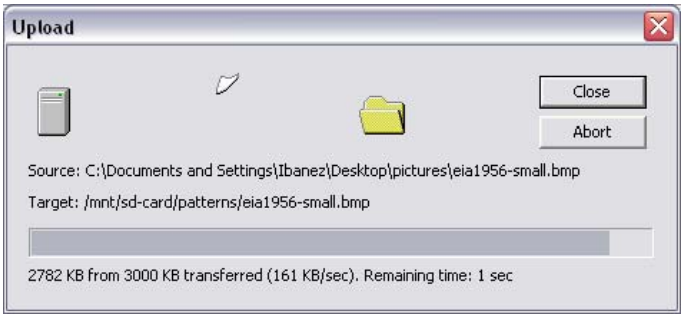


Figure 6.12. *Open image file Upload progress dialog (image files).*

- **Image file list right mouse button**. Clicking with the right mouse button over on the file names listed in *"Remote files"* dialog opens a menu where the user can execute the following actions:
    - *Select All*. Selects all the list elements.
    - *Invert selection*.
    - *Delete*. Deletes from remote memory the selected image files.
    - *Save to Disk*. Download the selected file from the remote hardware to the PC host. Even when several files are selected, only one file will be downloaded.

- *Assign to frame buffer*. The user can select a frame buffer among the 62 available frame buffers where the image file will be loaded to. Even when several files are selected, only one file will be loaded into the frame buffer.

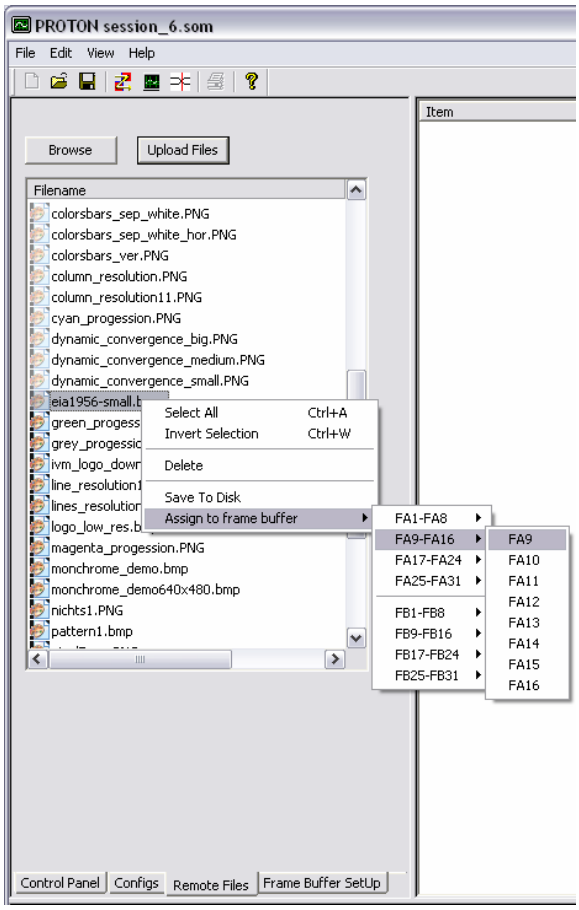


Figure 6.13. *Frame buffer assignment (image files).*

6.3.2 Frame buffer setup control Dialog

The frame buffer setup control dialog shows an overall view of the pictures assigned to the frame buffers. There are 62 different combo box dialog items distributed in 4 tabs, each combo box lists the same files are listed in the *"Remote Files"* control dialog. The selected item within a combo box points to the file to be loaded in the corresponding frame buffer during start up or on execution of the picture loading script.

Selecting the option *"No file"* in a combo box, will let the memory area associated to it free, i.e. random contents on the SDRAM after power up.

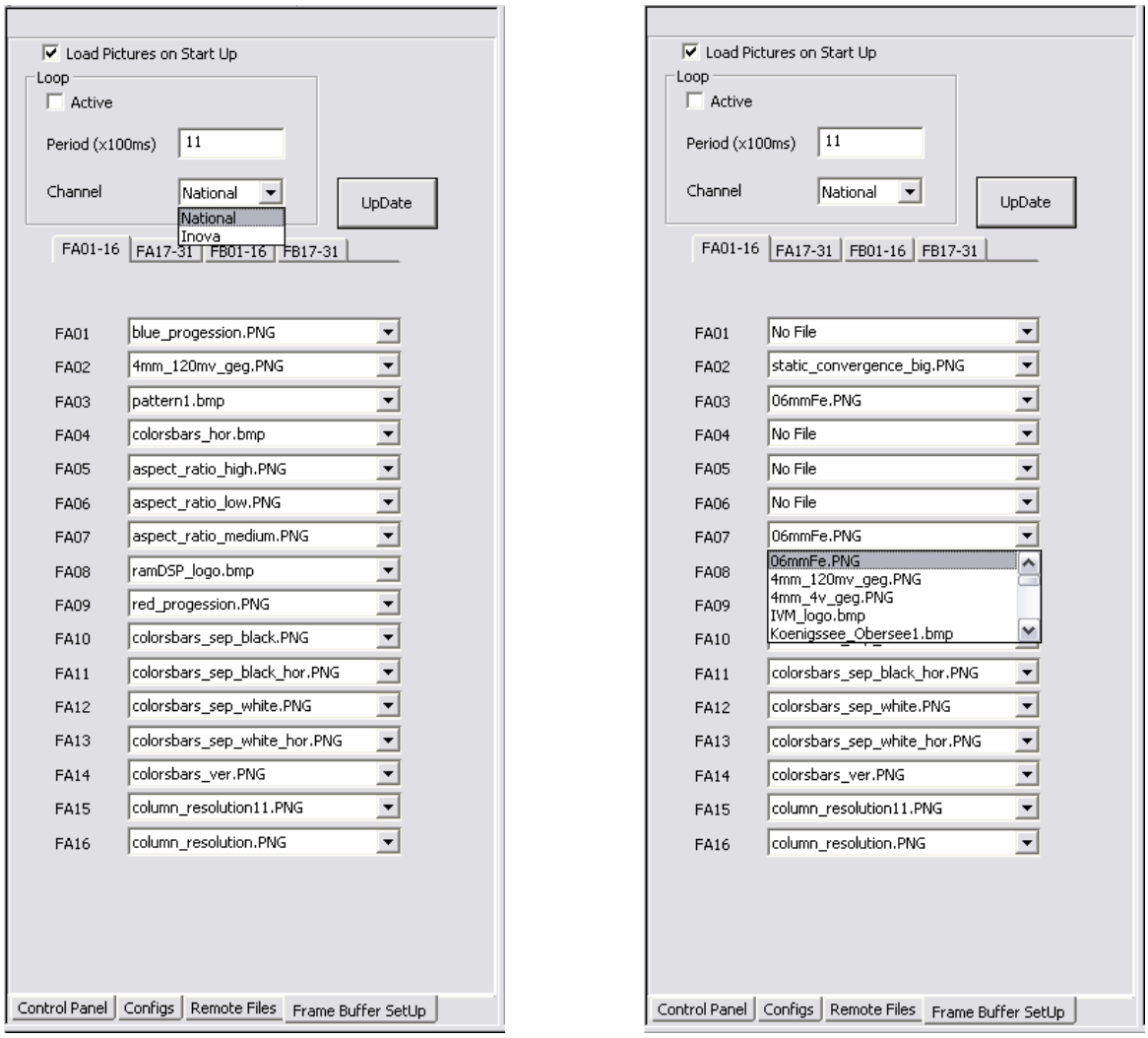


Figure 6.14. *Frame buffer Set up dialog (image files).*

- **Load pictures on start up check button**. If checked, the files selected in the combo boxes (frame buffer pattern assignment) will be loaded automatically on start up. If unchecked, the memory will be empty (not initialized).

PROTON-LVDS can swap automatically the frame buffers located in memory block A assigned to video channels INOVA or NATIONAL semiconductors. An infinite loop changes the selected video channel configuration with a programmed period configured by the user. Gathered under *"Loop"* group box the following menu items are found:

- **Active check button**. If checked, the picture loop script will be executed.
- **Period (x100ms) edit field**. Value in hundreds of milliseconds of the period on which the selected video channel configuration is reprogrammed.

- **Channel ComboBox.** Selects the targeted video channel. The Picture loop can be only executed on INOVA or National Semiconductor video channels.

Finally, the "*Update*" button will upload the settings to the remote hardware.

6.3.3 Configs control Dialog

Via this dialog the user can browse, upload, erase and download configuration files from and to the non volatile memory of PROTON-LVDS.

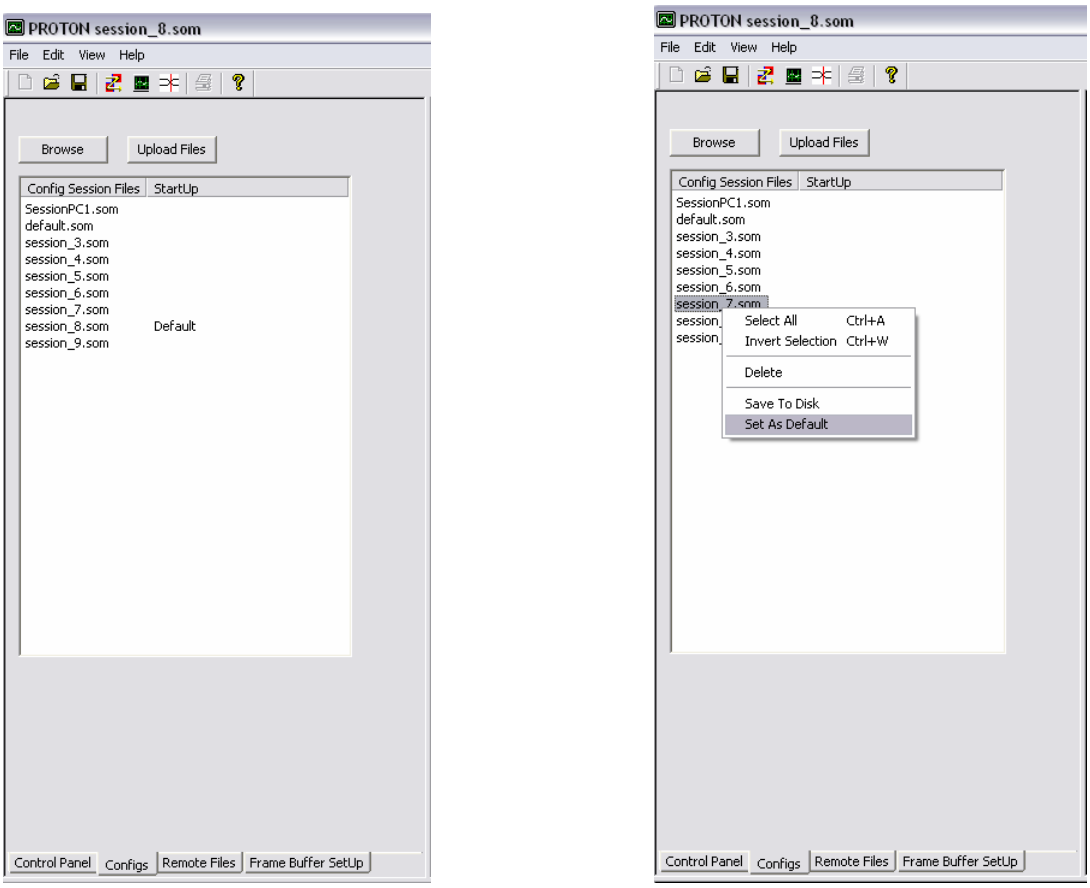


Figure 6.15. *Configs Control dialog (configuration files).*

- **Browse Button**. Updates the lists of configuration files in the nonvolatile memory of PROTON-LVDS.
- **Upload Files Button**. Opens a file selection dialog where the user can browse for PROTON-LVDS configuration files (*.som) in the PC host file system.

- **Configuration file list**. The first column lists the configuration files in the nonvolatile memory of PROTON-LVDS. The second columns shows which file is selected as default and loaded on system start up.
- **Configuration file list right mouse button**. Clicking with the right mouse button over on the file names listed in *"Configs"* dialog opens a menu where the user can execute the following actions:
    - *Select All*. Selects all the list elements.
    - *Invert selection*.
    - *Delete*. Deletes from remote memory the selected configuration files.
    - *Save to Disk*. Downloads the selected file from the remote hardware to the PC host. Even when several files are selected, only one file will be downloaded.
    - *Set as default*. Sets the selected file as default configuration file which will be loaded on system start up.

6.3.4 Control Panel dialog (LVDS NATIONAL/INOVA)

The control panel dialog on NATIONAL and INOVA video channels allows the user to configure the following parameters:

- Frame buffer number from which the NATIONAL/INOVA transmitter fetches the image data.
- Enable or disable the memory read.
- Frame buffer where the NATIONAL/INOVA receiver writes the data.
- Enable or disable the memory write.
- The transmitter mode. The video channel can be configured as a LVDS repeater or as a generator. The transmitter as LVDS repeater uses the same timing signals coming from the LVDS receiver channel (pixel clock, hsync, vsync and enable). The video image data is still independent. The transmitter as LVDS generator creates the video timing from the user programmed configuration.
- User selected timing configuration.

- User selected RGB configuration on LVDS serialiser chip data bus.
- User selected RGB configuration on LVDS deserialiser chip data bus.
- LVDS chip configuration.

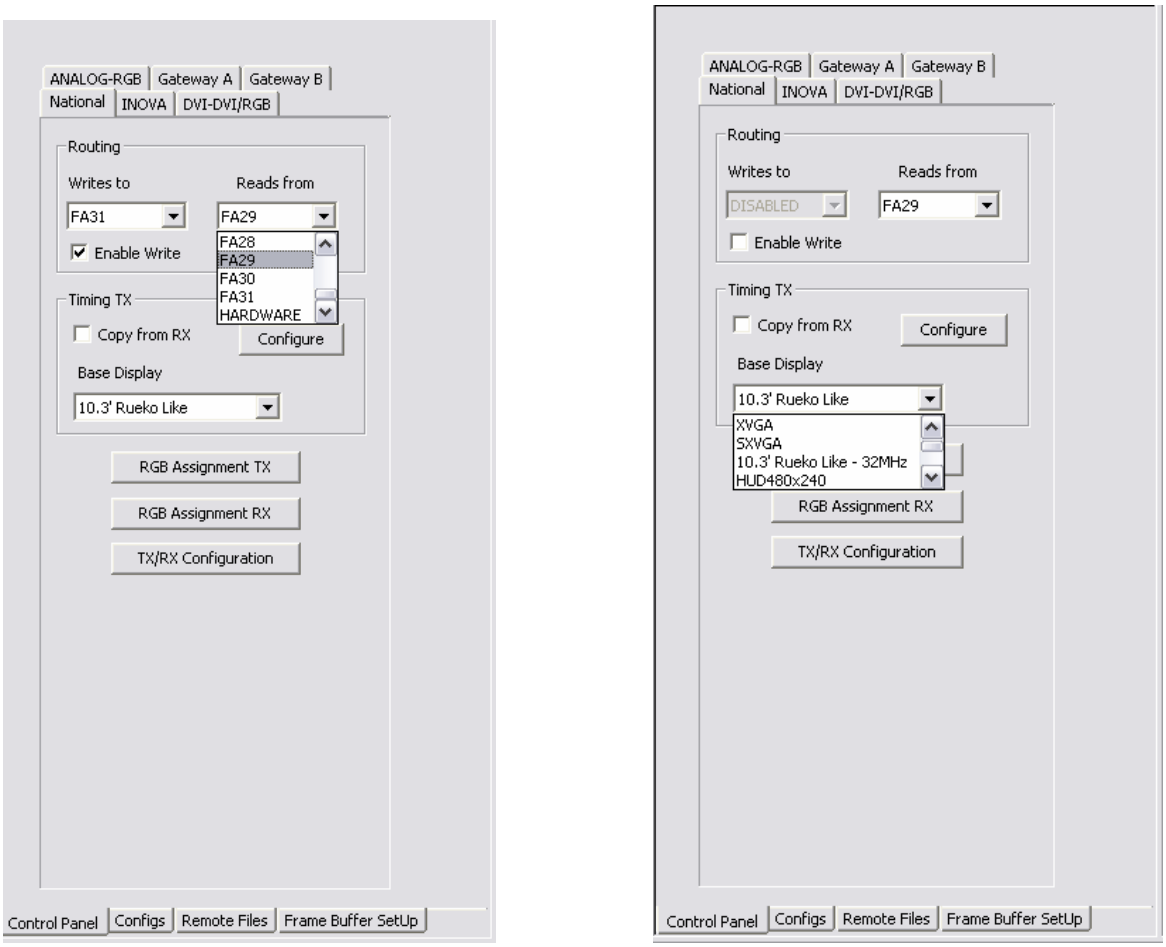


Figure 6.16. *National semiconductor video channel setup dialog (INOVA similar).*

The following menu items are available to configure the video channel parameters.

- **Writes to Combo box**. Selects the frame buffer the video channel writes to.
- **Reads from Combo box**. Selects the frame buffer the video channel reads from. When selecting HARDWARE the memory read is disabled and video data is replaced by a fixed color pattern generated by hardware (FPGA basis).
- **Enable write Check button**. If checked the NATIONAL/INOVA receiver block writes to the selected frame buffer on the corresponding combo box dialog item. If unchecked the NATIONAL/INOVA receiver doesn't write to memory.

- **Copy from RX.** If checked the NATIONAL/INOVA transmitter will act as a repeater using pixel clock, Hsync, Vsync and enable signal from the incoming video signal in the LVDS receiver. If unchecked, PROTON-LVDS generates the video timing accordingly to the user configuration.
- **Base display Combo box.** Selects a display type from display data base. Timing extracted from the display type specifications (typical values) will be used to program the video generator.
- **Configure push button.** Pressing this button opens a dialog where the timing parameters (typical values) of the selected display on base display combo box can be edited. These are the actual values loaded into the video generator. Next table enumerates the parameters can be changed by the user via timing display dialog.

Display type			
Parameter	*Units*	*Range*	*Resolution*
pixel clock	Hz	1MHz-150MHz	+-100KHz
Horizontal sync pulse	pixel clocks	1-2048	+/-1
Horizontal sync period	pixel clocks	1-2048	+/-1
Horizontal Back porch	pixel clocks	1-2048	+/-1
Horizontal Front porch	pixel clocks	1-2048	+/-1
Horizontal active time	pixel clocks	1-2048	+/-1
Vertical sync pulse	lines	1-2048	+/-1
Vertical sync period	lines	1-2048	+/-1
Vertical Back porch	lines	1-2048	+/-1
Vertical Front porch	lines	1-2048	+/-1
Vertical active time	lines	1-2048	+/-1
Phase Horizontal and vertical Sync	pixel clocks	-10-10	+/-1
Sync polarity	--	High-Low	--
Enable mode	--	High-Low	--

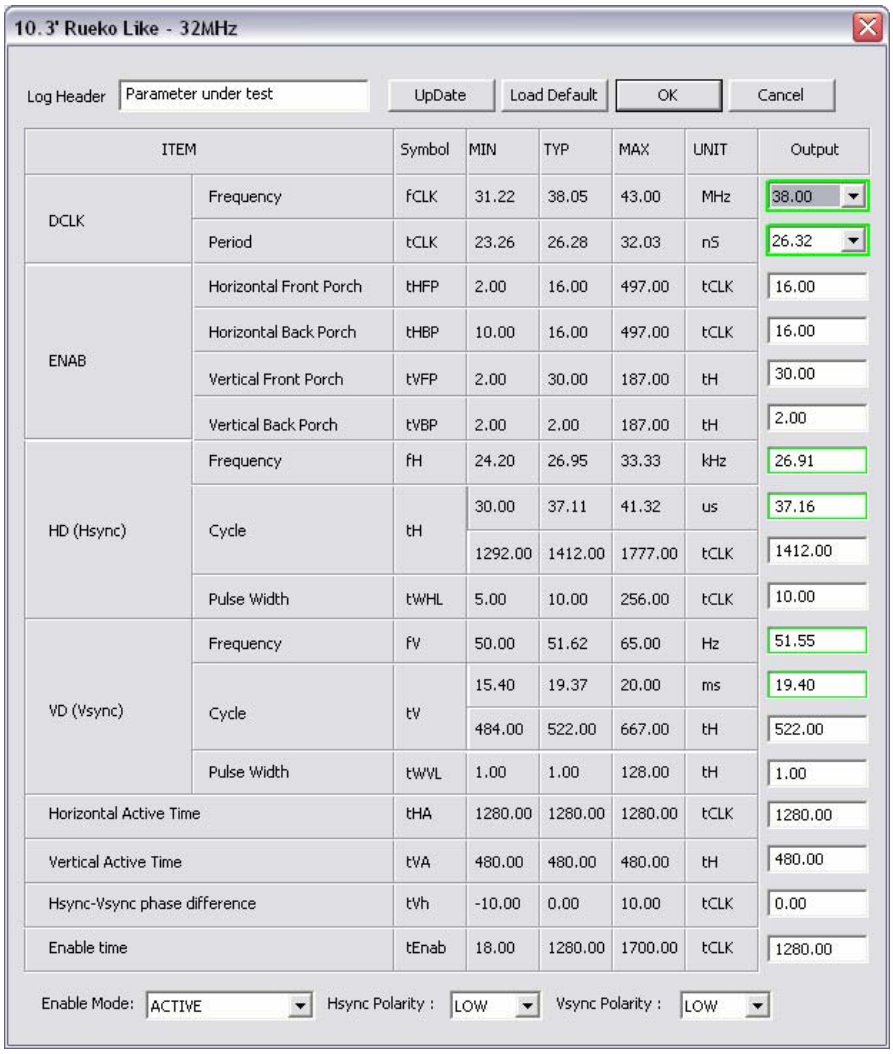


Figure 6.17. *Timing display, TX configuration.*

- **RGB assignment TX push button.** Pressing this button opens a dialog where the pin assignment for the NATIONAL/INOVA LVDS transmitter channel can be configured.

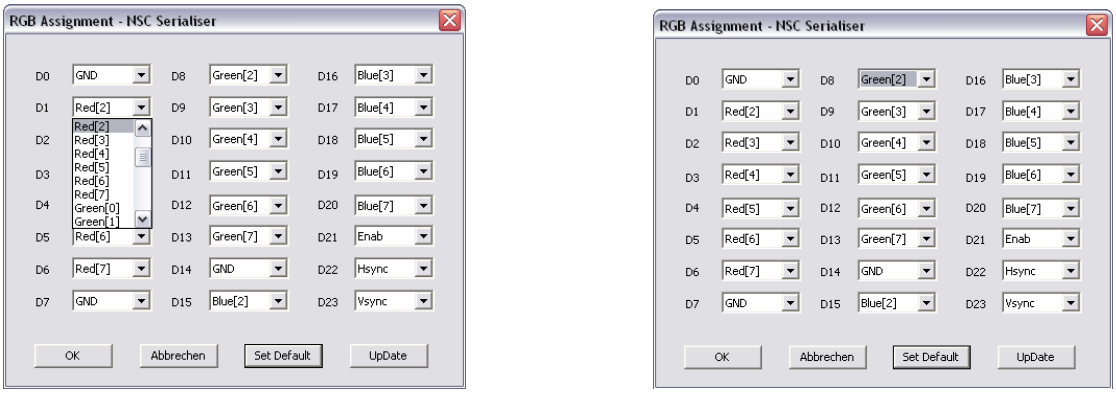


Figure 6.18. *RGB assignment National TX (Inova similar).*

- **RGB assignment RX push button.** Pressing this button opens a dialog where the pin assignment for the NATIONAL/INOVA LVDS receiver channel can be configured.

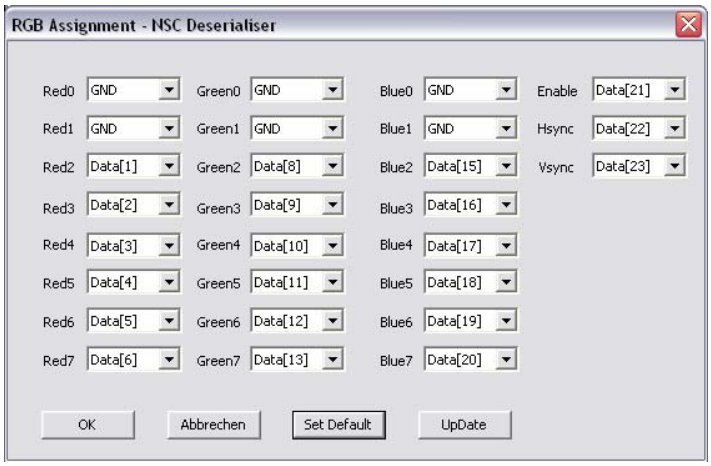


Figure 6.19. *RGB assignment National RX (Inova similar).*

- **TX/RX LVDS chip configuration push button (National).** Opens a dialog where the LVDS transmitter and receiver chip can be configured. Next table enumerates the chip parameters that can be programmed. For more details on this parameters refer to the corresponding datasheet.

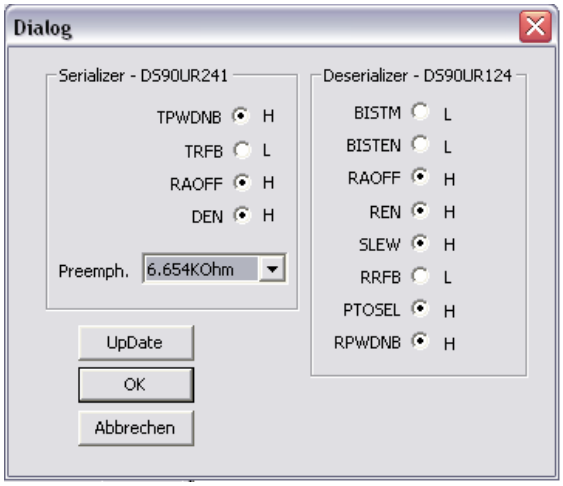


Figure 6.20. *National Semiconductors PC software configuration dialog*

DS90UR241		DS90UR124	
Signals	*Mode*	*Signals*	*Mode*
TPWDNB	write	BISTM	write
TRFB	write	BISTEN	write
RAOFF	write	RAOFF	write
DEN	write	REN	write
Preemph.	Write	SLEW	write
		RRFB	write
		PTOSEL	write
		RPWDNB	write

DS90UR241		DS90UR124	
Signals	*Mode*	*Signals*	*Mode*
		PASS	read
		LOCK	read

Next table lists DS90UR124 configurable parameters with a brief description.

RRFB	CMOS_I	**R**eceiver **R**ising **F**alling **Bar** clock Edge Select RRFB = H; ROUT LVTTL O/P clocked on **R**ising CLK RRFB = L; ROUT LVTTL O/P clocked on **F**alling CLK
REN	CMOS_I	**R**eceiver **EN**able, (ACTIVE H) REN = L; disabled, ROUT[23-0] and RCLK TRI-STATED, PLL still operational REN = H; **EN**abled
RPWDNB	CMOS_I	**R**eceiver **P**o**W**er **D**ow**N** **B**ar (ACTIVE L) RPWDNB = L; disabled, ROUT[23-0], RCLK, and LOCK are TRI-STATED in stand-by mode, PLL is shutdown RPWDNB = H; **EN**abled.
PTOSEL	CMOS_I	**P**rogressive **T**urn **O**n **SEL**ect. PTO = L (default); 1 UI adjustment PTO = H; grp1 2UI ahead, grp2 1UI ahead, grp3 1 UI behind
BISTEN	CMOS_I	@speed_**BIST ENable** (ACTIVE H) BISTEN = L; (default), OFF BISTEN = H; BIST enabled. Set DS90UR241 DIN[23-0] all LOW or floating. Check PASS condition.
BISTM	CMOS_I	**BIST** error reporting **M**ode selection BISTM = L; (default), Status of all ROUT with respective bit error on cycle-by-cycle basis BISTM = H; Total accumulated bit error counter on R[7:0] (up to 255)
RAOFF	CMOS_I	Additional Randomizer OFF (ACTIVE H) RAOFF = L; (default) additional randomization ON RAOFF = H; additional randomization OFF (backwards compatible with DS90C124)
SLEW	CMOS_I	LVTTL O/P **SLEW** rate control. SLEW = 0; (default) SLEW = 1; 2X drive/edge rate

Next table lists DS90UR241 configurable parameters with a brief description.

TPWDNB	CMOS_I	**T**ransmitter **P**o**W**er **D**ow**N** **B**ar (ACTIVE L). TPWDNB = L; disabled, DOUT (+/-) are TRI-STATED stand-by mode, PLL is shutdown TPWDNB = H; **EN**abled,
DEN	CMOS_I	**D**ata **EN**able (ACTIVE H) DEN = L; disabled, DOUT (+/-) are TRI-STATED, PLL still operational DEN = H: **EN**abled .
TRFB	CMOS_I	**T**ransmitter **R**ising/**F**alling **B**ar Clock Edge Select TRFB = L; falling edge TRFB = H; rising edge
RAOFF	CMOS_I	Additional **RA**ndomizer **OFF**. (ACTIVE H) RAOFF = L; default, 2^7 LSFR; RAOFF = H; backwards compatible with DS90**C**124

- **TX/RX LVDS chip configuration push button (Inova).** Opens a dialog where the LVDS transmitter and receiver chip can be configured. Next table enumerates the chip parameters that can be programmed. For more details on this parameters refer to the corresponding datasheet.

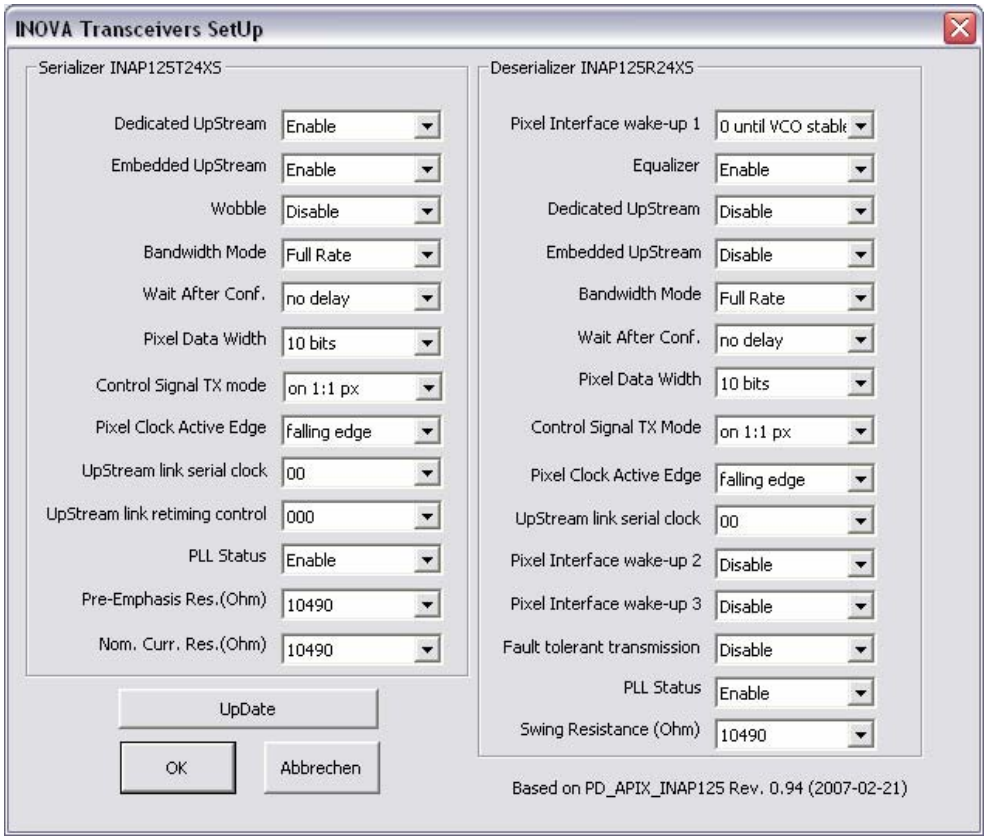


Figure 6.21. *INOVA LVDS transceivers PC software configuration dialog*

The following table enumerates INOVA INAP125R24XS (LVDS receiver) parameters with a brief description.

Address (hex)	Bit #	Parameter	Recommended configuration value	Comment
00	7:0	PROM_start	1011_1101	PROM valid byte 0
01	0	reserved	1	
	1	pixel interface wake-up 1		0: force pixel interface to "0" until VCO is stable 1: pixel interface is always enabled
	2	equalizer		0: enable equalizer 1: disable equalizer
	3	dedicated upstream		0: disable 1: enable dedicated upstream link Note: in case bits 3 and 4 are set to '1', the upstream channel is disabled
	4	embedded upstream		0: disable 1: enable Note: in case bits 3 and 4 are set to '1', the upstream channel is disabled
	5	reserved	0	reserved
	6	bandwidth mode		0: full rate 1: half rate
	7	wait period after configuration	1	0: no delay 1: 50 ms delay after configuration to stabilize the PLL
02	1:0	pixel data width		00: 10 bit 01: 12 bit 10: 18 bit 11: 24 bit
	3:2	control signal transmit mode	11	configure transmission of pixel control signals 00: never; 01: unused; 10: on every second (even) pixels; 11: on each pixel
	4	reserved	1	reserved
	5	pixel clock active edge		0: falling edge 1: rising edge
	7:6	upstream link serial clock		For detailed information refer to chapter 4.1.3
03	0	reserved	0	
	1	pixel interface wake-up 2		PX_DATA and PX_CTRL start at the upper left corner 0: disable 1: enable
	2	pixel interface wake-up 3		PX_CLK starts at the upper left corner 0: disable 1: enable
	3	fault tolerant transmission	1	tolerates single bit errors within the timing window 0: disable 1: enable
	7:4	reserved	0000	reserved
04	0	pll status	0	0: loss of PLL synchronization resets device 1: disable
	7:1	reserved	0000110	
05	7:0	reserved	00000001	reserved
06	7:0	reserved	00000000	reserved
07	7:0	PROM_end	1001_1001	PROM valid byte 1

The following table enumerates INOVA INAP125T24XS (LVDS transmitter) parameters with a brief description.

Address (hex)	Bit #	Parameter	Recommended configuration value	Comment
00	7:0	PROM_start	1011_1101	PROM valid byte 0
01	2:0	pre-emphasis control	000	000
	3	dedicated upstream		0: enable dedicated upstream link 1: disable Note: in case bit 3 and 4 are set to '0', the upstream channel is disabled
	4	embedded upstream		0: enable embedded upstream link 1: disable Note: in case bit 3 and 4 are set to '0', the upstream channel is disabled
	5	wobble		wobble of transmission frequency 0: enable 1: disable
	6	bandwidth mode		0: half rate 1: full rate
	7	wait period after configuration	1	0: no delay 1: 50 ms delay after configuration to stabilize the PLL
02	1:0	pixel data width		selects the width of pixel data to be transmitted 00: 10 bit 01: 12 bit 10: 18 bit 11: 24 bit
	3:2	control signal transmit mode	11	configure transmission of pixel control signals 00: never; 01: unused; 10: on every second (even) pixels; 11: on each pixel
	4	reserved	1	Reserved
	5	pixel clock active edge		0: falling edge 1: rising edge
	7:6	upstream link serial clock		For detailed information refer to chapter 4.1.3
03	3:0	upstream link retiming control		For detailed information refer to chapter 4.1.4
	7:4	reserved	0000	Reserved
04	0	pll status		loss of PLL synchronization resets device 0: enable 1: disable
	4:1	reserved	1000	Reserved
	7:5	reserved	100	Reserved
05	7:0	PROM_end	1001_1001	PROM valid byte 1

6.3.5 Control Panel dialog (DVI-DVI/RGB)

The control panel dialog on DVI-DVI/RGB video channels allows the user to configure the following parameters on DVI transmitter and DVI/RGB receiver:

- Frame buffer number from which the DVI transmitter fetches the image data.
- Enable or disable the memory read for DVI output channel.
- Frame buffer where the DVI/RGB receiver writes the data into memory.
- Enable or disable the memory write.
- User selected timing configuration for DVI transmitter.
- DVI/RGB Receiver configuration.
- DVI transmitter configuration.

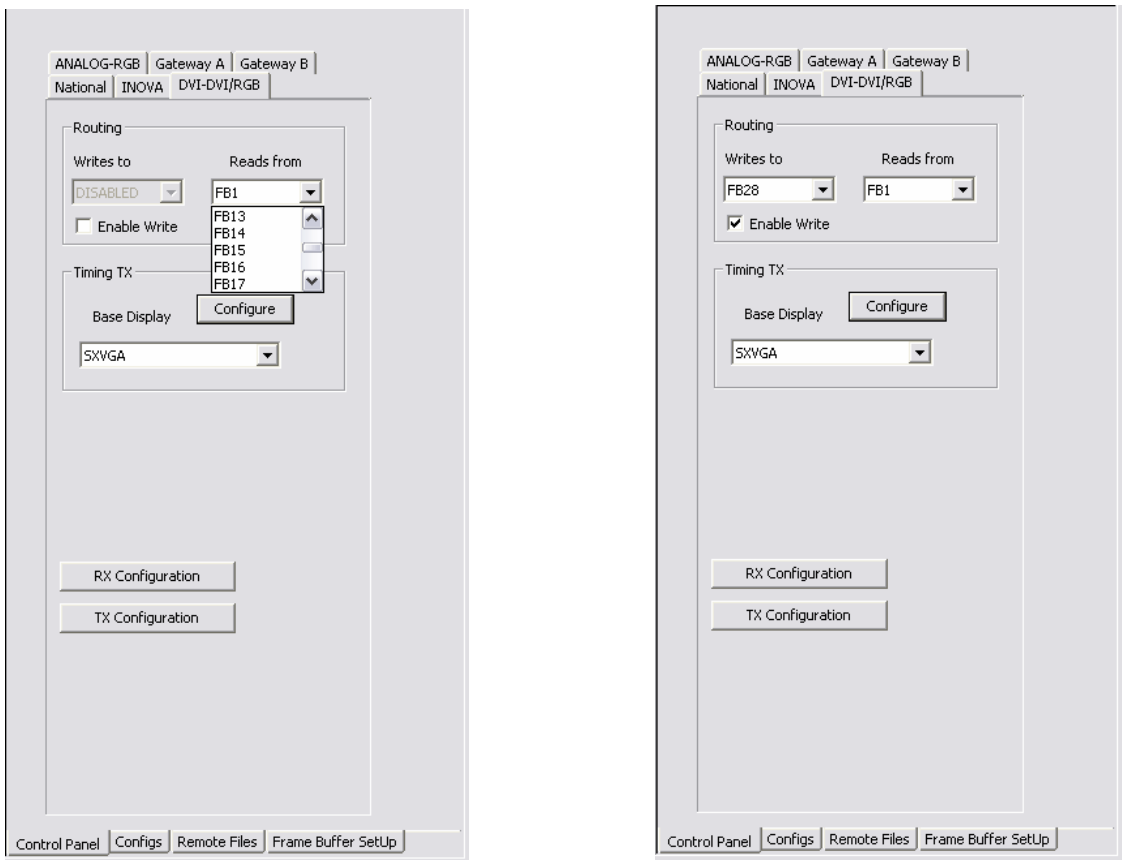


Figure 6.22. *DVI-DVI/RGB control dialog*

The following menu items are available to configure the video channel parameters.

- **Writes to Combo box**. Selects the frame buffer the video channel writes to.
- **Reads from Combo box**. Selects the frame buffer the video channel reads from. When selecting HARDWARE the memory read is disabled and video data is replaced by a fixed color pattern generated by hardware (FPGA basis).
- **Enable write Check button**. If checked the RGB/DVI receiver block writes to the selected frame buffer on the corresponding combo box dialog item. If unchecked the DVI/RGB receiver doesn't write to memory.
- **Base display Combo box.** Selects a display type from display data base. Timing extracted from the display type specifications (typical values) will be used to program the video generator.
- **Configure push button.** Pressing this button opens a dialog where the timing parameters (typical values) of the selected display on base display combo box can be

edited. These are the actual values loaded into the video generator. Next table enumerates the parameters can be changed by the user via timing display dialog.

Display type			
Parameter	*Units*	*Range*	*Resolution*
pixel clock	Hz	1MHz-150MHz	+-100KHz
Horizontal sync pulse	pixel clocks	1-2048	+/-1
Horizontal sync period	pixel clocks	1-2048	+/-1
Horizontal Back porch	pixel clocks	1-2048	+/-1
Horizontal Front porch	pixel clocks	1-2048	+/-1
Horizontal active time	pixel clocks	1-2048	+/-1
Vertical sync pulse	lines	1-2048	+/-1
Vertical sync period	lines	1-2048	+/-1
Vertical Back porch	lines	1-2048	+/-1
Vertical Front porch	lines	1-2048	+/-1
Vertical active time	lines	1-2048	+/-1
Phase Horizontal and vertical Sync	pixel clocks	-10-10	+/-1
Sync polarity	--	High-Low	--
Enable mode	--	High-Low	--

- **RX Configuration push button.** Pressing this button opens a dialog where the internal register of the AD9887A RGB/DVI receiver can be programmed. Next figure shows the dialog for configuring the chip. The Scroll bar in the dialog display/selects 8 registers among all internal registers. The dialog permit allows modify single registers or the whole register bank with only push button. The *"Default all"* push button loads the default Chip configuration. For more information on chip parameters refer to the corresponding datasheet.

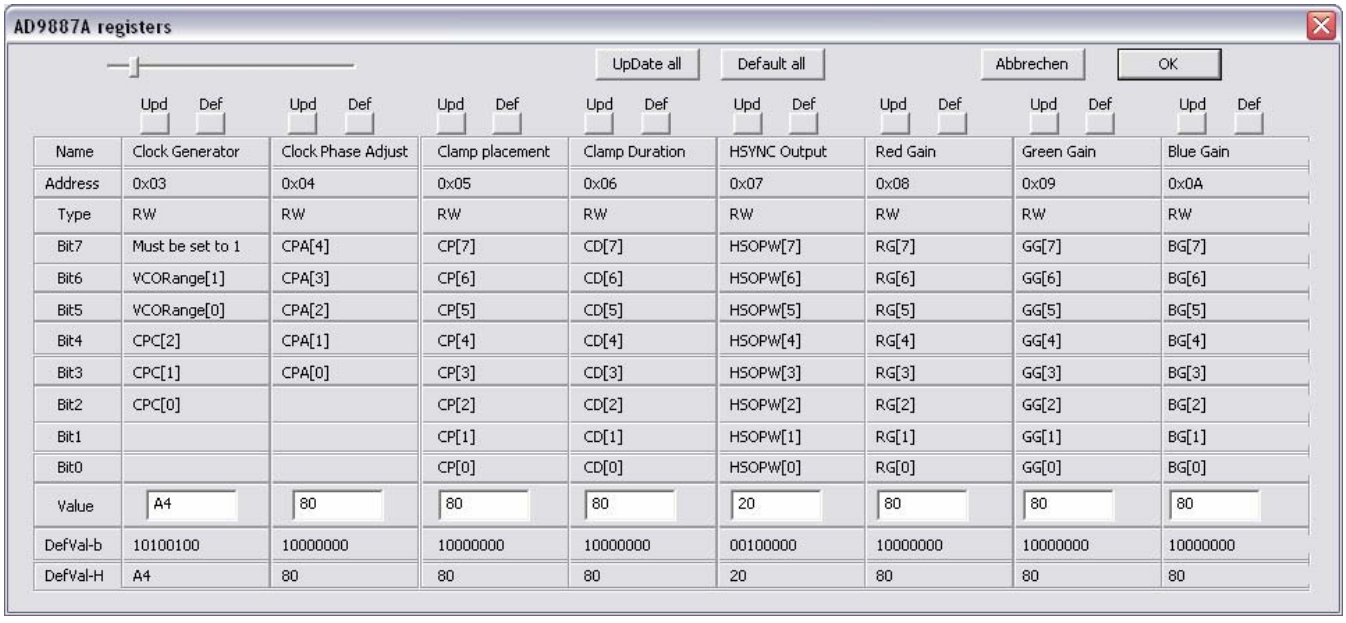
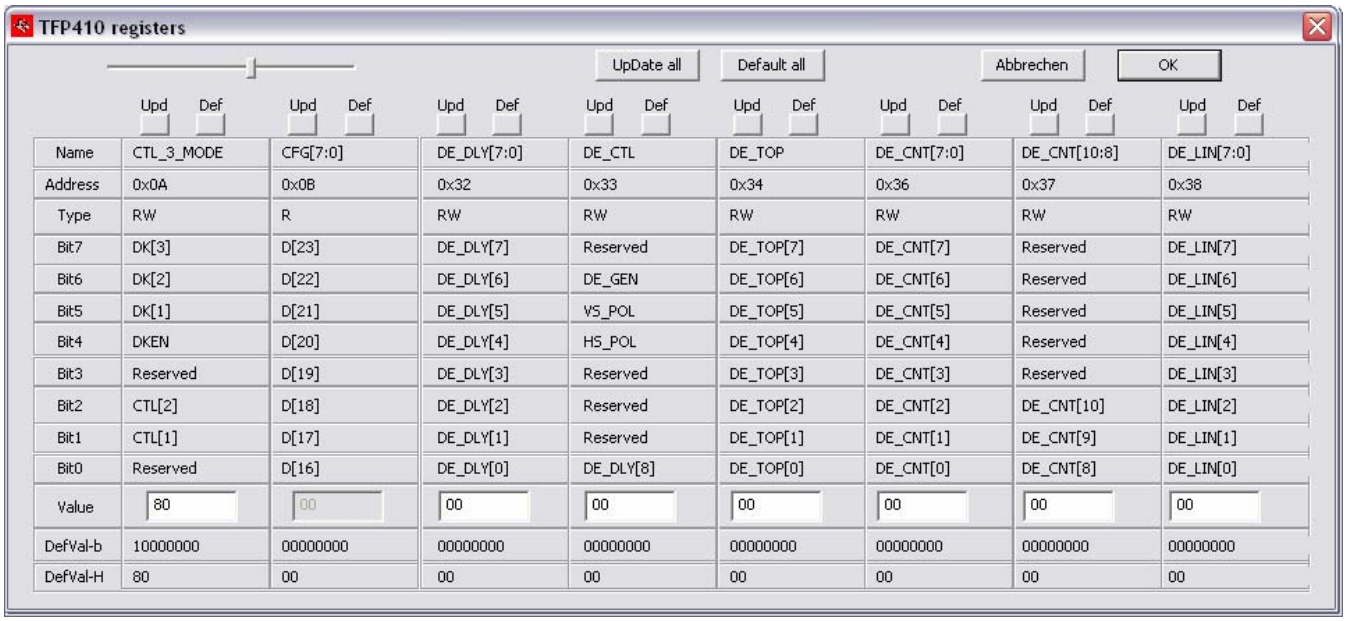


Figure 6.23. *AD9887A DVI/RGB internal registers dialog*

- **TX Configuration push button.** Pressing this button opens a dialog where the internal register of the TFP410 DVI transmitter can be programmed. Next figure shows the dialog for configuring the chip. The Scroll bar in the dialog display/selects 8 registers among the internal registers. The dialog permit allows modify single registers or the whole register bank with only push button. The *"Default all"* push button loads the default Chip configuration. For more information on chip parameters refer to the corresponding datasheet.



Name	CTL_3_MODE	CFG[7:0]	DE_DLY[7:0]	DE_CTL	DE_TOP	DE_CNT[7:0]	DE_CNT[10:8]	DE_LIN[7:0]
Address	0x0A	0x0B	0x32	0x33	0x34	0x36	0x37	0x38
Type	RW	R	RW	RW	RW	RW	RW	RW
Bit7	DK[3]	D[23]	DE_DLY[7]	Reserved	DE_TOP[7]	DE_CNT[7]	Reserved	DE_LIN[7]
Bit6	DK[2]	D[22]	DE_DLY[6]	DE_GEN	DE_TOP[6]	DE_CNT[6]	Reserved	DE_LIN[6]
Bit5	DK[1]	D[21]	DE_DLY[5]	VS_POL	DE_TOP[5]	DE_CNT[5]	Reserved	DE_LIN[5]
Bit4	DKEN	D[20]	DE_DLY[4]	HS_POL	DE_TOP[4]	DE_CNT[4]	Reserved	DE_LIN[4]
Bit3	Reserved	D[19]	DE_DLY[3]	Reserved	DE_TOP[3]	DE_CNT[3]	Reserved	DE_LIN[3]
Bit2	CTL[2]	D[18]	DE_DLY[2]	Reserved	DE_TOP[2]	DE_CNT[2]	DE_CNT[10]	DE_LIN[2]
Bit1	CTL[1]	D[17]	DE_DLY[1]	Reserved	DE_TOP[1]	DE_CNT[1]	DE_CNT[9]	DE_LIN[1]
Bit0	Reserved	D[16]	DE_DLY[0]	DE_DLY[8]	DE_TOP[0]	DE_CNT[0]	DE_CNT[8]	DE_LIN[0]
Value	80	00	00	00	00	00	00	00
DefVal-b	10000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
DefVal-H	80	00	00	00	00	00	00	00

Figure 6.24. *TFP410 DVI transmitter internal registers dialog*

6.3.6 Control Panel dialog (ANALOG-RGB)

The control panel dialog on ANALOG-RGB video channels allows the user to configure the following parameters on Analog video receiver and RGB transmitter:

- Frame buffer number from which the RGB transmitter fetches the image data.
- Enable or disable the memory read for RGB output channel.
- Frame buffer where the Analog video receiver writes the data into memory.
- Enable or disable the memory write for this channel.
- User selected timing configuration for RGB transmitter.

- Analog video Receiver configuration.
- RGB transmitter configuration (digital to analog video converter).

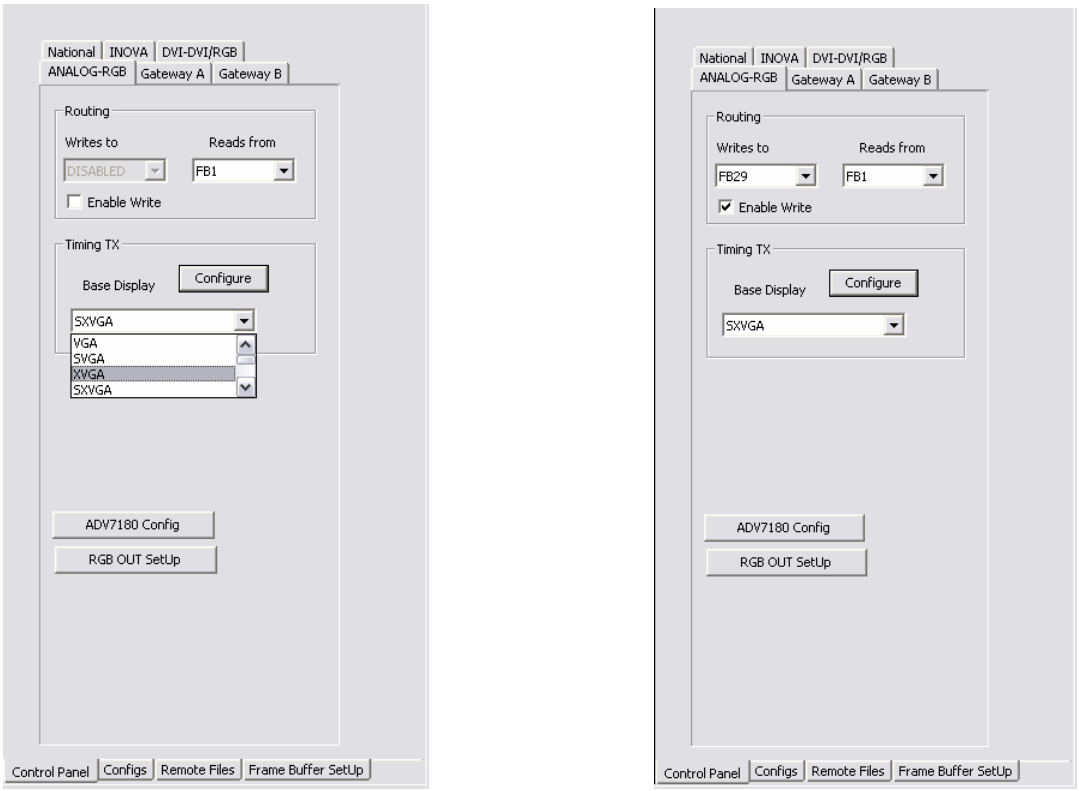


Figure 6.25. *ANALOG-RGB Control dialog*

The following menu items are available to configure the video channel parameters.

- **Writes to Combo box**. Selects the frame buffer the video channel writes to.
- **Reads from Combo box**. Selects the frame buffer the video channel reads from. When selecting HARDWARE the memory read is disabled and video data is replaced by a fixed color pattern generated by hardware (FPGA basis).
- **Enable write Check button**. If checked the ANALOG video receiver block writes to the selected frame buffer on the corresponding combo box dialog item. If unchecked the ANALOG video receiver doesn't write to memory.
- **Base display Combo box.** Selects a display type from display data base. Timing extracted from the display type specifications (typical values) will be used to program the video generator.

- **Configure push button.** Pressing this button opens a dialog where the timing parameters (typical values) of the selected display on base display combo box can be edited. These are the actual values loaded into the video generator. Next table enumerates the parameters can be changed by the user via timing display dialog.

Display type			
Parameter	*Units*	*Range*	*Resolution*
pixel clock	Hz	1MHz-150MHz	+-100KHz
Horizontal sync pulse	pixel clocks	1-2048	+/-1
Horizontal sync period	pixel clocks	1-2048	+/-1
Horizontal Back porch	pixel clocks	1-2048	+/-1
Horizontal Front porch	pixel clocks	1-2048	+/-1
Horizontal active time	pixel clocks	1-2048	+/-1
Vertical sync pulse	lines	1-2048	+/-1
Vertical sync period	lines	1-2048	+/-1
Vertical Back porch	lines	1-2048	+/-1
Vertical Front porch	lines	1-2048	+/-1
Vertical active time	lines	1-2048	+/-1
Phase Horizontal and vertical Sync	pixel clocks	-10-10	+/-1
Sync polarity	--	High-Low	--
Enable mode	--	High-Low	--

- **ADV7180 Config push button.** Pressing this button opens a dialog where the internal register of the ADV7180 Analog video decoder can be programmed. Next figure shows the dialog for configuring the chip. The Scroll bar in the dialog display/selects 8 registers among all internal registers. The dialog permit allows modify single registers or the whole register bank with only push button. The *"Default all"* push button loads the default Chip configuration. For more information on chip parameters refer to the corresponding datasheet.

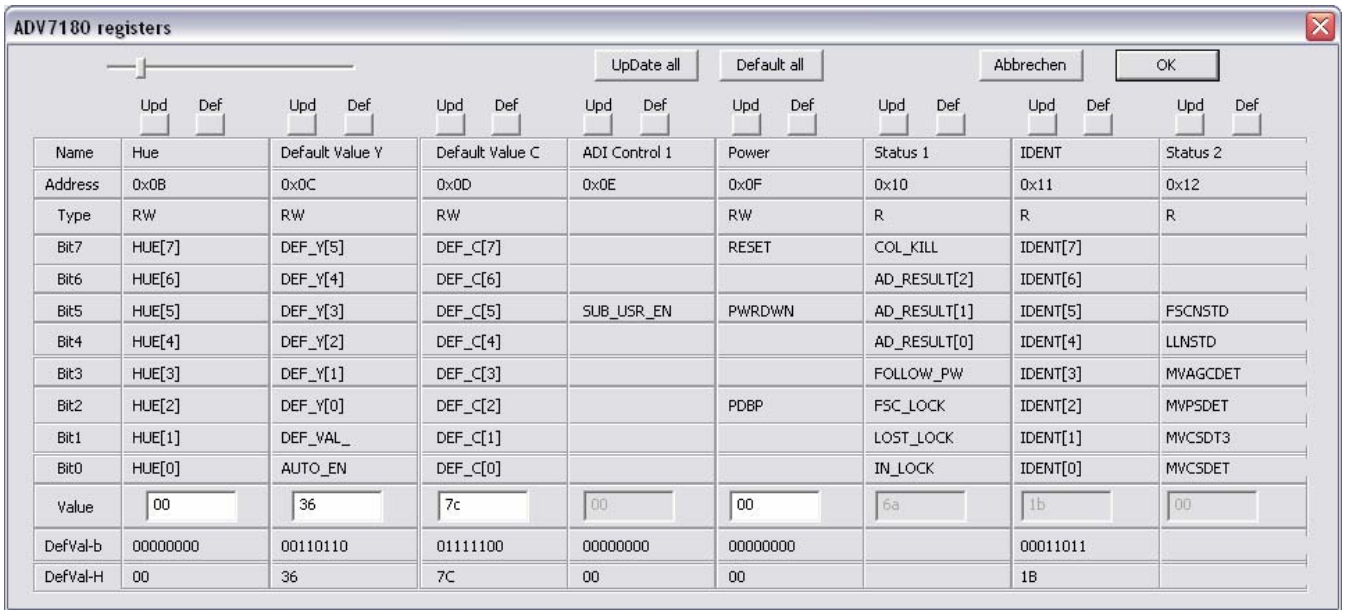


Figure 6.26. *ADV7180 internal registers dialog*

- **RGB OUT setup push button.** Pressing this button opens a dialog where the pin configuration of the RGB digital to analog converter can be modified. For more information on chip parameters refer to the corresponding datasheet.

Figure 6.27. *THS8133 digital to analog convert pin setup*

6.3.7 Control Panel dialog (Gateway A/Gateway B)

The control panel dialog on Gateway A / Gateway B video channels allows the user to configure the following parameters:

- Frame buffer number from which the Gateway A / Gateway B transmitter fetches the image data.
- Enable or disable the memory read for Gateway A / Gateway B output channel.

- Frame buffer where the Gateway A / Gateway B receiver writes the data into memory.
- Enable or disable the memory write for this channel.
- User selected timing configuration for Gateway A / Gateway B transmitter. Except pixel clock which is fixed programmed to 26MHz.

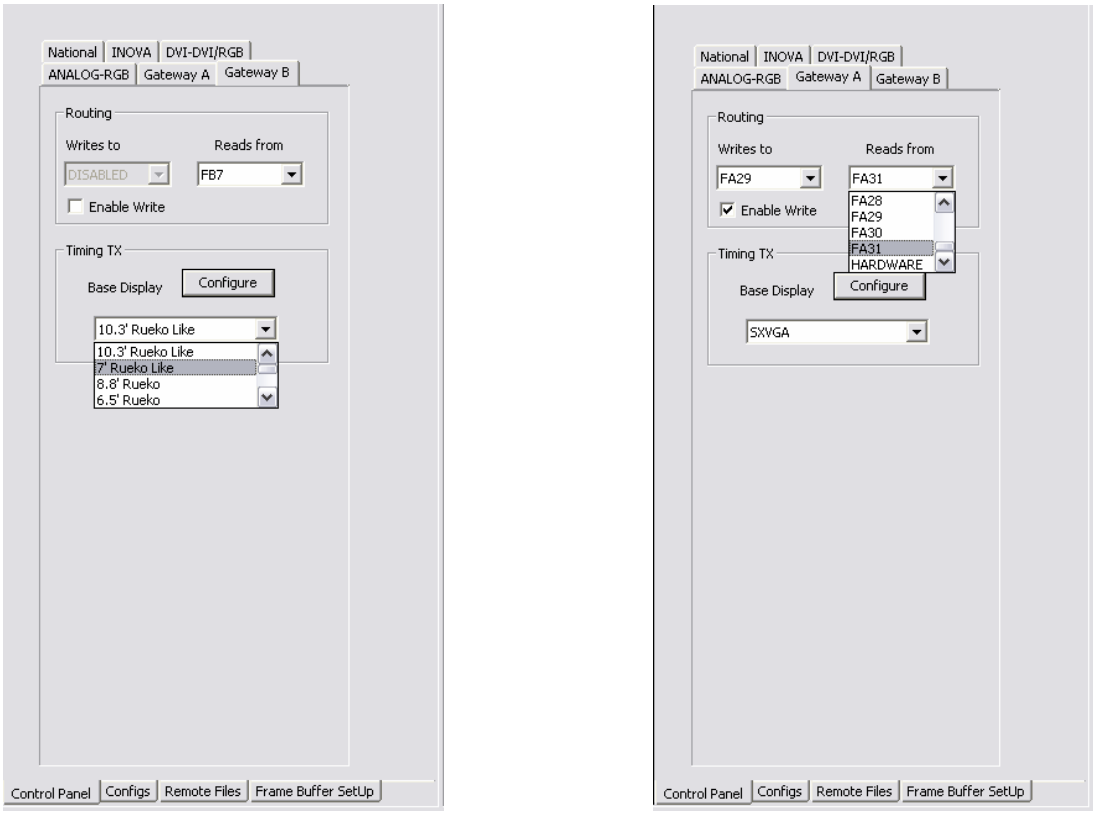


Figure 6.28. *Gateway A/B Control dialog*

The following menu items are available to configure the video channel parameters.

- **Writes to Combo box**. Selects the frame buffer the video channel writes to.
- **Reads from Combo box**. Selects the frame buffer the video channel reads from. When selecting HARDWARE the memory read is disabled and video data is replaced by a fixed color pattern generated by hardware (FPGA basis).
- **Enable write Check button**. If checked the Gateway A/B receiver block writes to the selected frame buffer on the corresponding combo box dialog item. If unchecked the Gateway A/B receiver doesn't write to memory.

- **Base display Combo box.** Selects a display type from display data base. Timing extracted from the display type specifications (typical values) will be used to program the video generator.
- **Configure push button.** Pressing this button opens a dialog where the timing parameters (typical values) of the selected display on base display combo box can be edited. These are the actual values loaded into the video generator. Next table enumerates the parameters can be changed by the user via timing display dialog.

Display type			
Parameter	*Units*	*Range*	*Resolution*
pixel clock Not programmable	--	--	--
Horizontal sync pulse	pixel clocks	1-2048	+/-1
Horizontal sync period	pixel clocks	1-2048	+/-1
Horizontal Back porch	pixel clocks	1-2048	+/-1
Horizontal Front porch	pixel clocks	1-2048	+/-1
Horizontal active time	pixel clocks	1-2048	+/-1
Vertical sync pulse	lines	1-2048	+/-1
Vertical sync period	lines	1-2048	+/-1
Vertical Back porch	lines	1-2048	+/-1
Vertical Front porch	lines	1-2048	+/-1
Vertical active time	lines	1-2048	+/-1
Phase Horizontal and vertical Sync	pixel clocks	-10-10	+/-1
Sync polarity	--	High-Low	--
Enable mode	--	High-Low	--

6.4 Status Bar

Status bar has two different functions:

- **CONNECT**. Shows whether the connection to the remote hardware has been established. After starting the GUI software, the Software status pane displays the “Not Connected” message/ICON. Before operating the software, the user must connect to the remote hardware successfully (Software status pane will display “Connected” message/ICON).
- **ERROR**. Display error messages sent by the remote hardware.

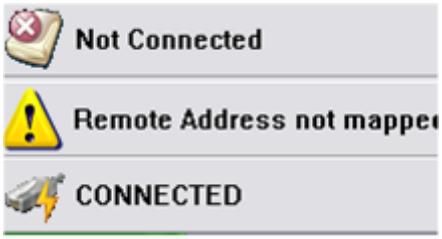


Figure 6.29. *Status Bar messages*

7 PROTON-LVDS Stand-Alone

Two rotary encoders and a 3.5 inches color LCD form the user interface that allows using PROTON-LVDS as stand alone system. Once configured and loaded with image files, by means the user interface elements, the device can be used without the need of a PC host.

To navigate through the graphical embedded application in PROTON-LVDS the rotary encoders must be used. They are MP (left rotary encoder) and VM (right rotary encoder). Next figure sketches the front plate of the system.

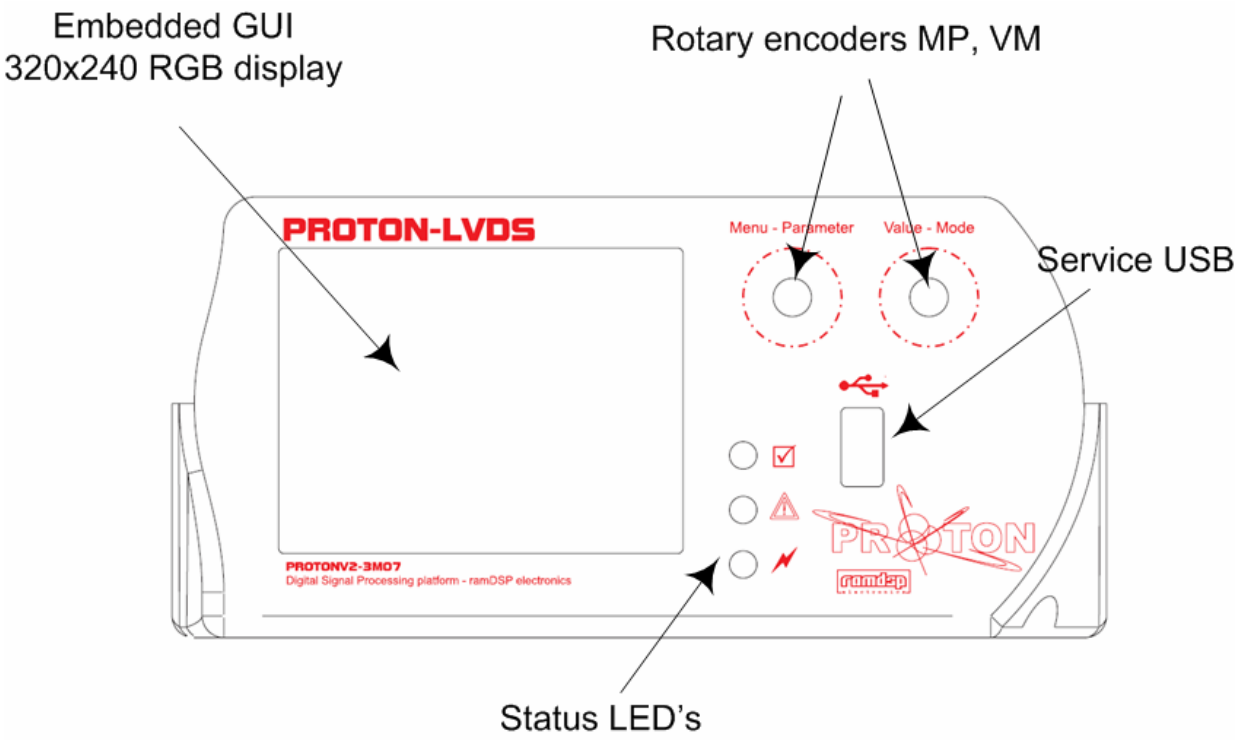


Figure 7.1A. *System front plate*

The embedded GUI screen is divided in two different areas, the system menu area and the status bar. The system menu area is where the application windows and menus are displayed in a dynamic way, i.e. windows and menus are replaced driving the rotary encoders of the system.

The status bar is the lower part of the screen and is static. It has always 7 visible fields no matter which part of the graphical embedded application is selected or a menu is displayed. The status bar is always visible and contains the following fields:

- **LVDS-NSC**. This field keeps track of the **`lock`** output pin of the National semiconductor LVDS receiver DS90UR124. When a stable LVDS data stream is received on PROTON-LVDS over NATIONAL video channel this status field will be highlighted.
- **LVDS-INO**. This field keeps track of the `RX-ERR0R` pin of the INOVA LVDS receiver INAP125R24. When a stable LVDS data stream is received on PROTON-LVDS over INOVA video channel this status field will be highlighted.
- **RGB**. This field is highlighted when the ADC converter assigned to the analog RGB video input recognizes a stable `hsync`.
- **DVI**. This field is highlighted when the DVI receiver of the system detects a stable DVI data stream.
- **ANALOG**. This field is highlighted when the analog video decoder of the system recognizes a stable analog video signal at its input, composite, S-Video or components.
- **CAN**. This field shows if CAN messages are being sent or received by the CAN controller of the system. When highlighted shows the bus load of the CAN bus connected to PROTON-LVDS.
- **DISK**. A green disk indicates that the system is connected to a PC host over Ethernet. An orange disk indicates that a script is being executed. A grey disk shows that none of the above conditions are met.

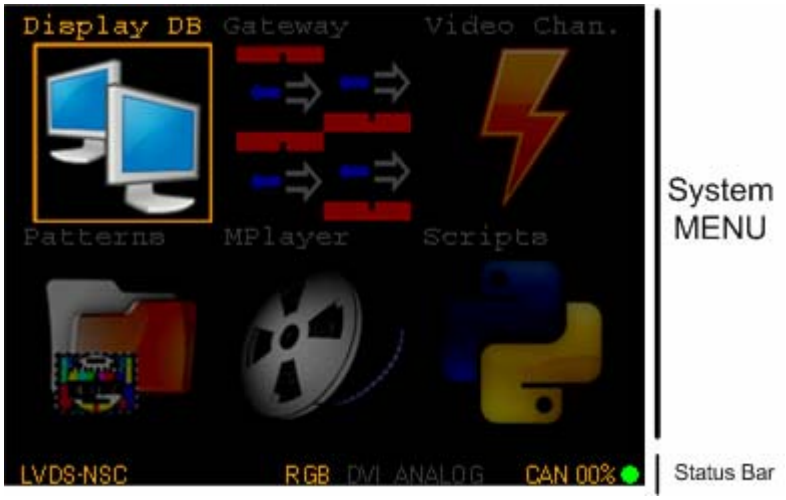


Figure 7.1B. *Embedded GUI screen*

The top level menu on the embedded GUI contains two windows with 6 selectable elements in each window. The elements can be selected by rotating the encoder MP (left rotary encoder). Once an element has been selected, its corresponding sub menu can be accessed pressing MP. Figure 7.2 lists all 12 menu elements found the TOP level menu.

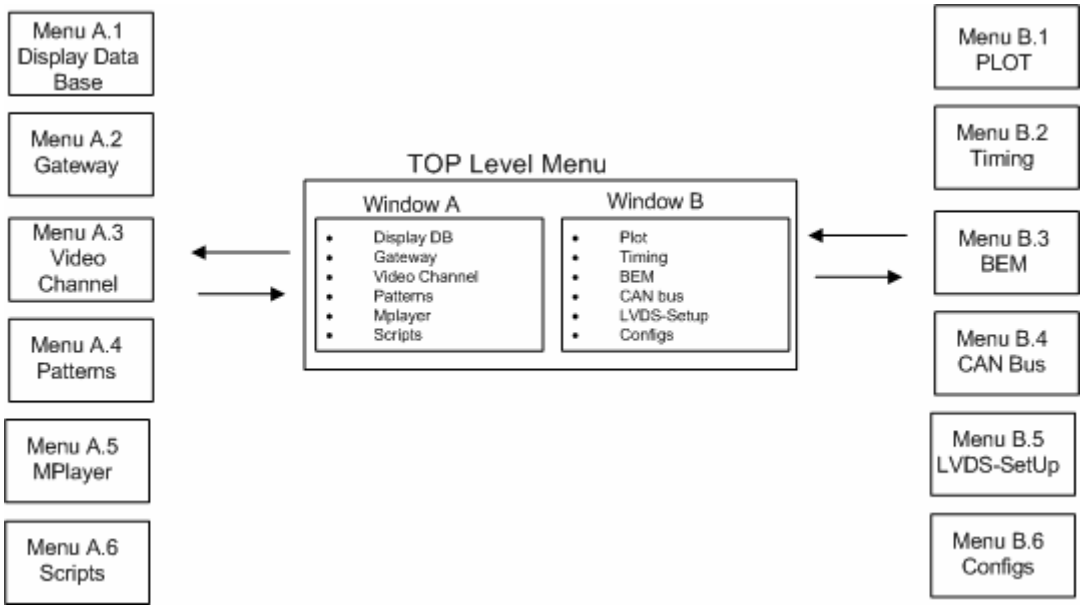


Figure 7.2. *Top level elements*

7.1 Menu A.1. Display DB

To access the display Data base/display types submenu from the top level menu, the user rotates MP until Display DB icon is selected as shown in next figure.

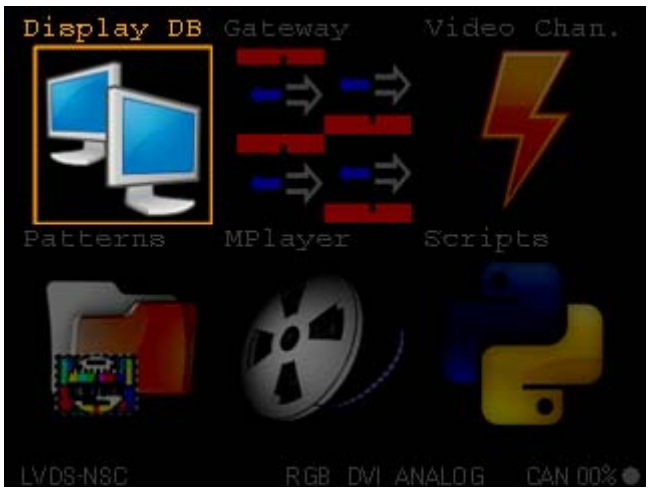


Figure 7.3. *Display Database TOP level menu selection*

Once selected, pressing MP the system shall print on the screen the submenu related to the display type data base. In this submenu the following functions are available:

- The display data base for a given configuration file contains 128 display specifications previously defined by the user via PROTON-LVDS PC application. This submenu allows the user browsing the display data base with two different views. A coarse view where only a few display parameters are shown; and a detailed view where the whole timing specification can be visualized.

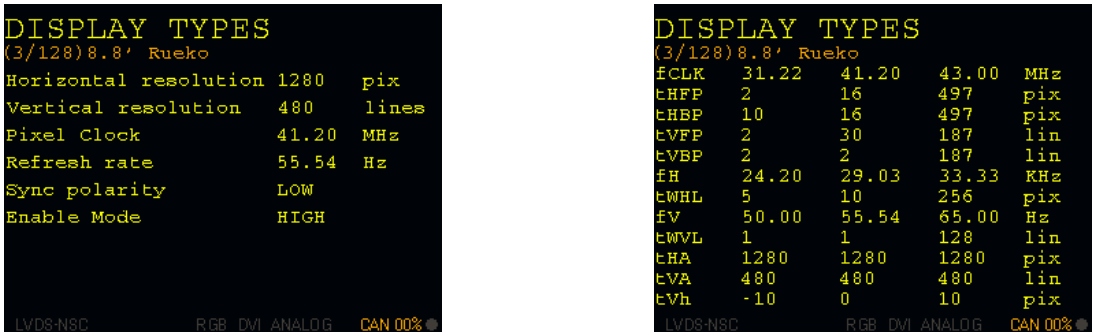


Figure 7.4. *Display Types, coarse and detailed view.*
Change between views by rotating VM (right rotary encoder)
.Change between display type by rotating MP (left rotary encoder)

- Loading a given display parameter set from the display data base to one of the video channels. To load a display type to a given video channel, select first the display type to be loaded by rotating MP. Once selected, press MP Button to enter the edit mode, a CYAN color string will be shown on the TOP right corner of the screen. Rotate then MP until the desired video channel is shown on the TOP right corner of the display as show in the following figure (in this case National semiconductor channel). Press MP to load the selected timing to video channel, or press VM for cancel.

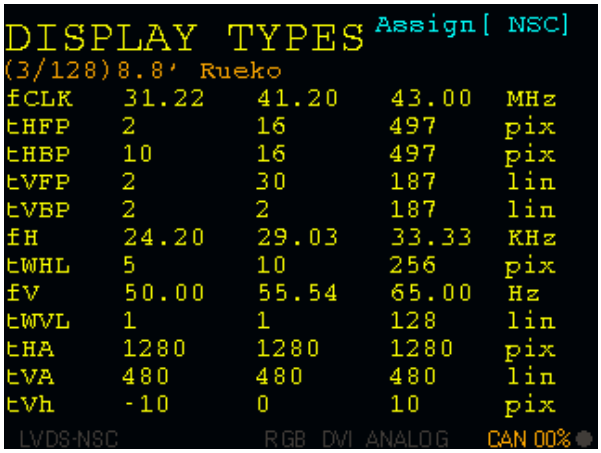


Figure 7.5. *Display Types, coarse and detailed view. Change between views by rotating VM (right rotary encoder).*

The following options are available in edit mode on display data base submenu:

Edit Option	load target
Assign[NSC]	National semiconductor video generator
Assign[INO]	INOVA semiconductor video generator
Assign[DVI]	DVI video generator
Assign[RGB]	RGB video generator
Assign[GATA]	GATA reads from memory block A
Assign[GATB]	GATB reads from memory block B

To exit the Display Data Sub Menu press to VM (right button).

7.2 Menu A.2 GateWay

To access the Video Gateway submenu from the top level menu, the user rotates MP until Gateway icon is selected as shown in next figure

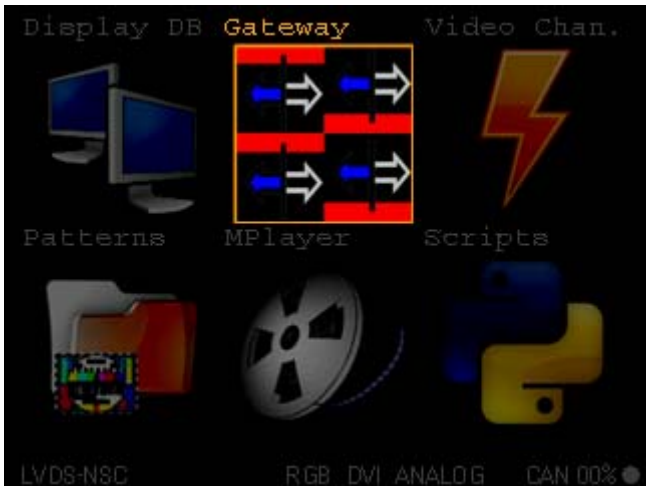


Figure 7.6. *GateWay TOP level menu selection*

Once selected, pressing MP Button the system shall print on the screen the submenu related to video gateway. In this submenu the video channels can be linked between each other by selecting the source of a given video output.

The Gateway Sub menu has two levels. On the first level, rotating MP the user selects the video output channel. The second level (edit mode) is entered by pressing MP Button. Once in

edit mode a CYAN color string (**Edit**) will be displayed on the TOP right corner of the screen, the selected source will be also marked on CYAN color, rotating VM different video sources are assigned progressively to the selected video output. To Exit the edit mode press VM Button. To exit the Gateway Menu Press VM Button.

Next figure shows the submenu structure and the required actions to reach the possible states.

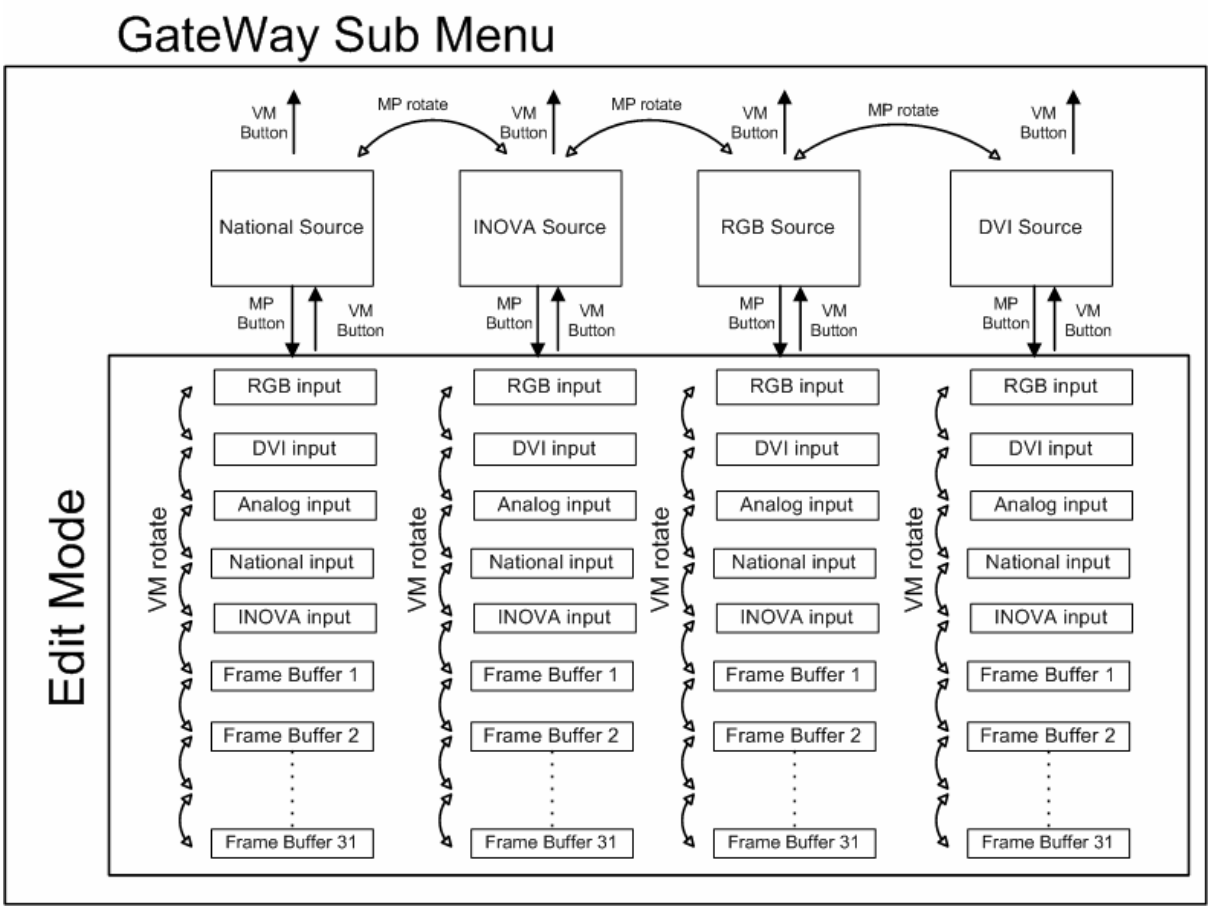


Figure 7.7. *GateWay Sub Menu structure*

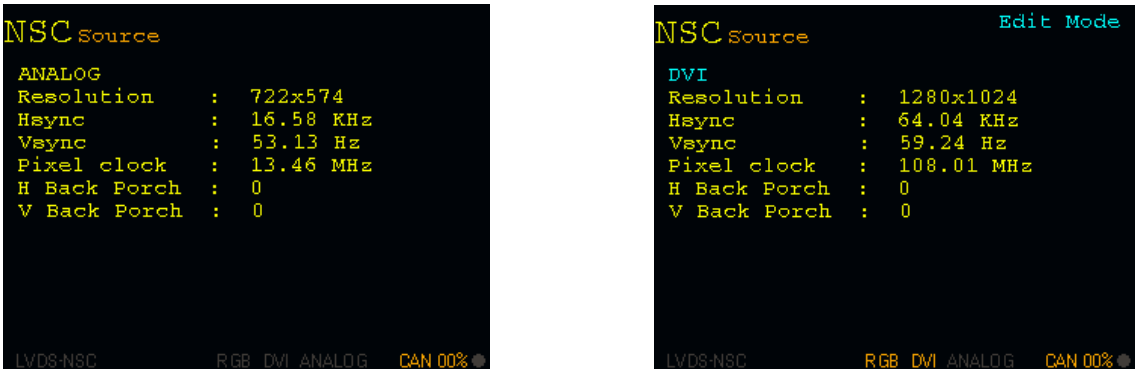


Figure 7.8. *GateWay Sub Menu screen shot. Display and edit mode.*
The user enters edit mode by pressing MP. The user exits edit mode by pressing VM.

7.3 Menu A.3 Video channel

To access the Video Channel submenu from the top level menu, the user rotates MP until **"Video Chan."** icon is selected as shown in next figure.

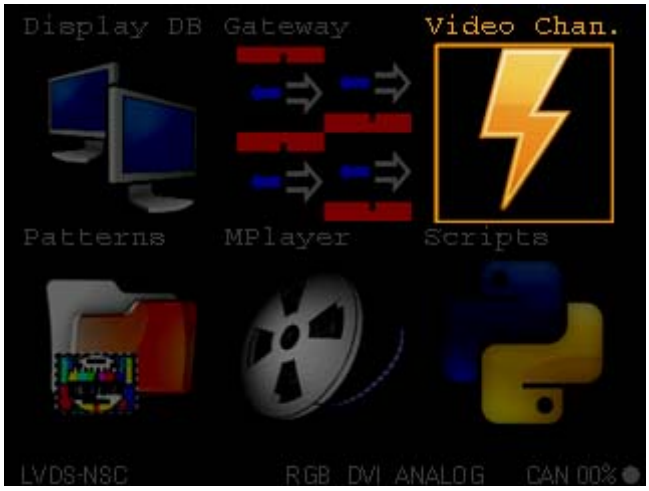


Figure 7.9. *Video Channel TOP level menu selection*

Once selected, pressing MP Button the system shall print on the screen the submenu related to video Channels. In this submenu the video channels can be configured independently on the following parameters.

Parameter	Description
Enable	Enables or disables the selected Video channel generator
Display Type	Selects the display type used in the video generator. As an option for National and INOVA channels, the display type can be copied from the RX channel (Copy from RX option).
Read Buffer	Selects the frame buffer the Video channel fetches the image data from.
Write Buffer	Selects the frame buffer the Video channel writes the image data to.
Read Offset X	Sets the offset in multiples of 8 pixels of the position of the first pixel in X direction in the image.
Read Offset Y	Sets the offset in multiples of 1 line of the position of the first line in Y direction within the image.
Write Offset X	Sets the offset in multiples of 8 pixels of the position of the first pixel in X direction in the frame buffer where the

Parameter	Description
	incoming data will be written.
Write Offset Y	Sets the offset in multiples of 1 line of the position of the first line in Y direction in the frame buffer where the incoming data will be written.
Window Size X	Sets the width of the image to be output on the video channel. It can't be bigger than the selected display horizontal resolution. If it's smaller a frame of color Background color will be used around the image data and centered. The size must be multiple of 8 pixels.
Window Size Y	Sets the height of the image to be output on the video channel. It can't be bigger than the selected display vertical resolution. If it's smaller a frame of color Background color will be used around the image data and centered.
Background color RED component	The red components of the frame color used when windowing the image data on the output video.
Background color GREEN component	The green components of the frame color used when windowing the image data on the output video.
Background color BLUE component	The blue components of the frame color used when windowing the image data on the output video.

The parameters described the table above can be accessed for every video channel in Edit mode. Edit mode is entering by pressing MP Button. In Edit mode a CYAN color string will be visible in the TOP right corner and at the same time the selected parameter will be marked also on CYAN color. To browse different parameters rotate MP. To edit a parameter once selected in edit mode rotate VM. To exit the Edit mode press VM. To exit the Video channels sub menu press VM.

Next figures show screenshots of the Video Channels menu, in normal and edit modes.

Figure 7.10. *Video Channel Submenu in normal and edit mode*

Next figure shows a window map of the Video Channel sub menu with the required actions to move between windows and menu items.

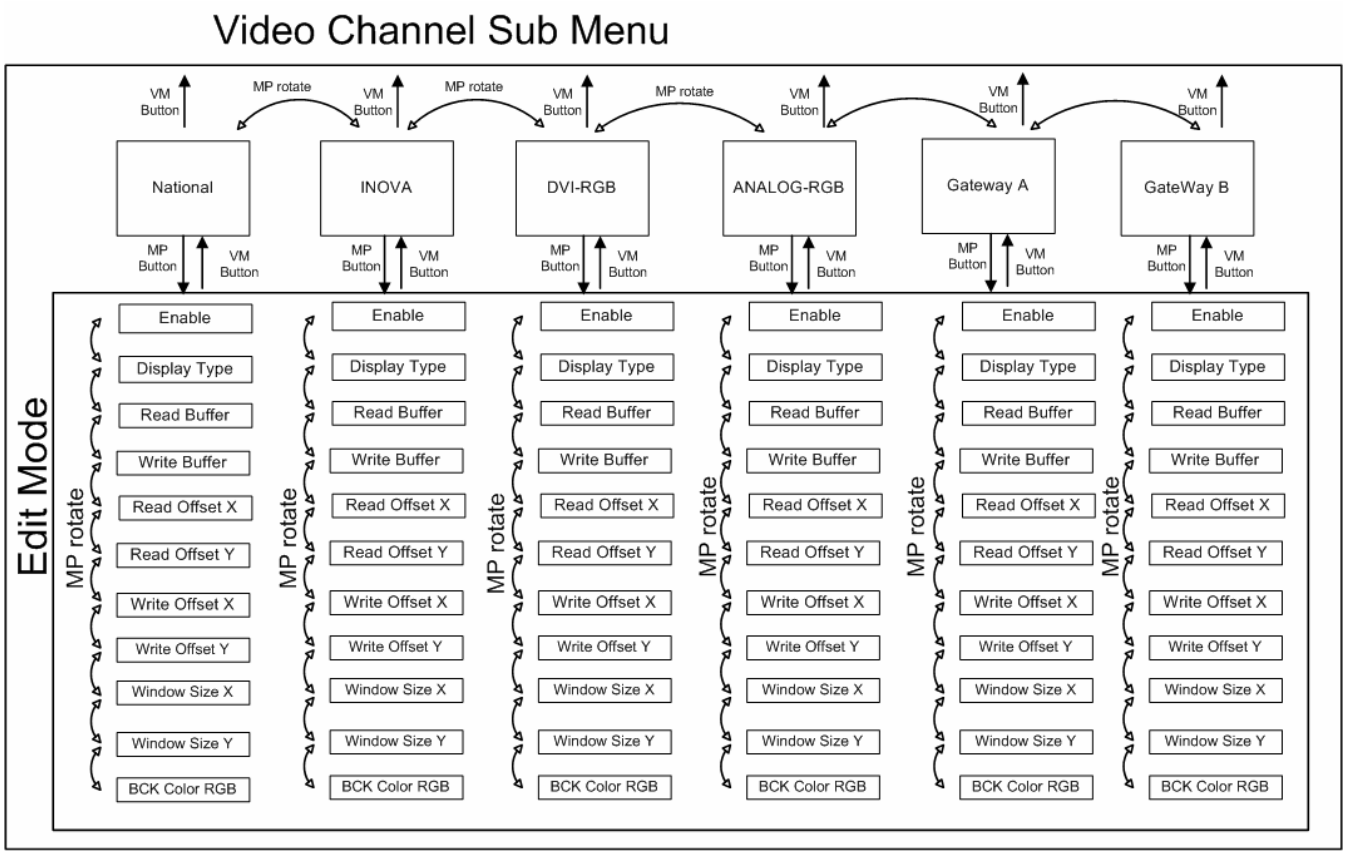


Figure 7.11. *Video Channel Sub Menu Structure*

7.4 Menu A.4 Patterns

To access the patterns submenu from the top level menu, the user rotates MP until **"Patterns"** icon is selected as shown in next figure.

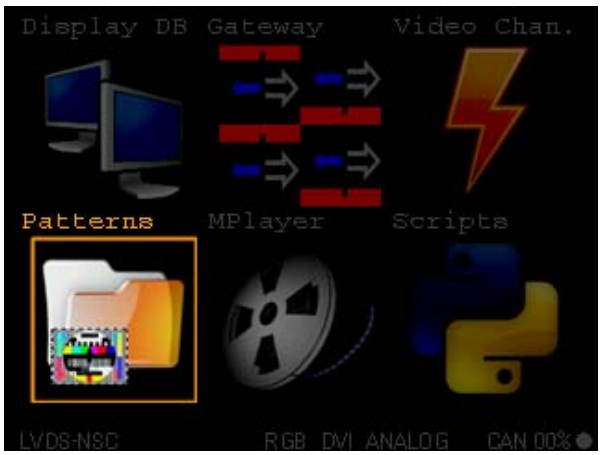


Figure 7.12. *Patterns TOP level menu selection*

Once selected, pressing MP Button the system shall print on the screen the submenu related to image patterns. In this submenu the user can browse the image files present in the nonvolatile memory and load them to an arbitrary frame buffer position. Next figure shows an example of a pattern located on position 18 from 52 images stored in nonvolatile memory. It informs about the picture name, the format and picture resolution. Rotating MP the user browses image files and displays the selected pattern preview progressively.

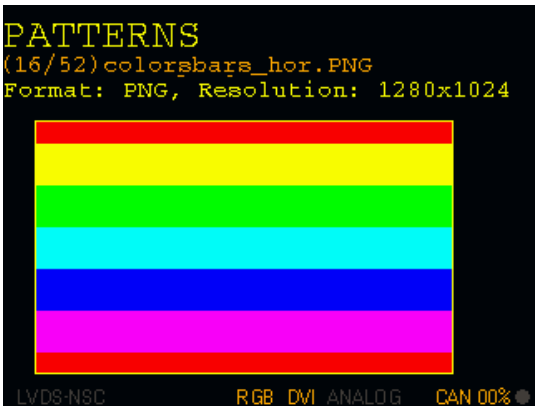


Figure 7.13. *Browsing image patterns on nonvolatile memory*

By pressing MP the menu enters in edit mode. In this mode the user can select a frame buffer position where to load the desired pattern. As depicted in the following picture, a CYAN string is shown on the TOP right corner of the screen indicating the frame buffer position where to load the image. Rotating VM a different frame buffer is selected. Pressing MP button triggers a DMA transfer that loads the selected pattern from nonvolatile memory to the frame buffer memory, during the data transfer a RED string will be printed on the TOP right corner of the screen. By pressing VM Button the menu exits edit mode. By pressing VM Button the system returns to Main TOP level menu exiting Patterns Sub menu.

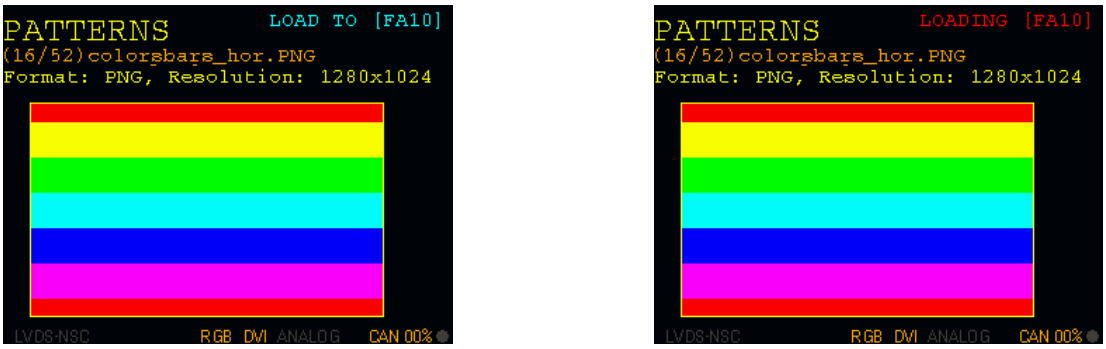


Figure 7.14. *Browsing image patterns on nonvolatile memory (edit mode).*

7.5 Menu A.5 MPlayer

To access the mplayer submenu from the top level menu, the user rotates MP until **"MPlayer"** icon is selected as shown in next figure.

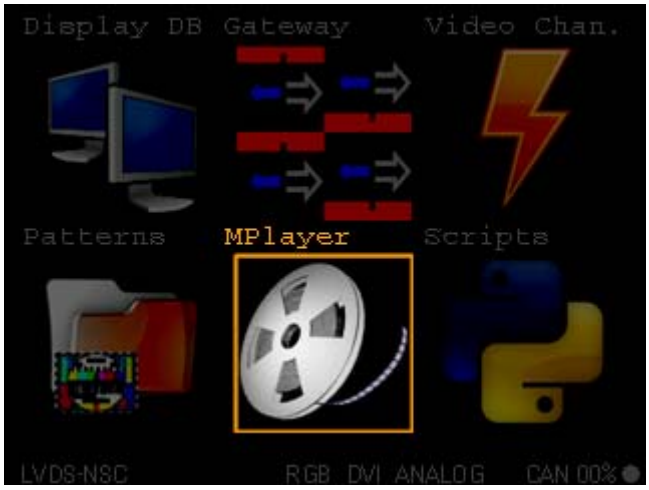


Figure 7.15. *MPayer TOP level menu selection*

7.6 Menu A.6 Scripts

To access the Scripts sub menu from the top level menu, the user rotates MP until **"Scripts"** icon is selected as shown in next figure.

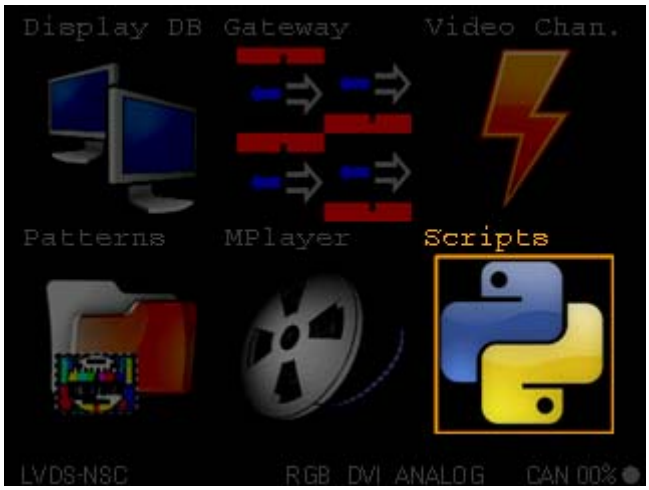


Figure 7.16. *Scripts TOP level menu selection*

Once selected, pressing MP Button the system shall print on the screen the submenu related to scripts. In this submenu the user can activate/deactivate and configure two different predefined scripts.

- Picture Loop. This script swaps cyclically the output picture of the National or Inova video channel using 31 frame buffer positions. The user can program how long a pattern will be displayed during the loop in steps of 0.1 seconds from 0.1seconds to 100 seconds. Only National and INOVA video channels support the picture loop functionality and only one of them can be selected at a time. Next figure shows the Picture Loop window in view and edit modes. To enter Edit mode press MP Button. To select a parameter rotate MP button. To change the selected parameter, rotate VM. To exit edit mode press VM button. To exit script submenu press VM button.

Figure 7.17. *Picture Loop window in view and edit mode.*

- Picture Loading. Loads all the patterns included in the system configuration file (see section 6.3.2. of this document) to their corresponding frame buffer position. To enter Edit mode press MP Button. To select a parameter rotate MP button. To change the selected parameter, rotate VM. To execute the picture loading script on demand:
    - Enter edit mode by pressing MP button.
    - Select the parameter Load Now by rotating MP (will be marked on CYAN).
    - Press MP Button. The script will be executed displaying a progress bar dialog indicating the number of picture files being loaded to the frame buffer memory.

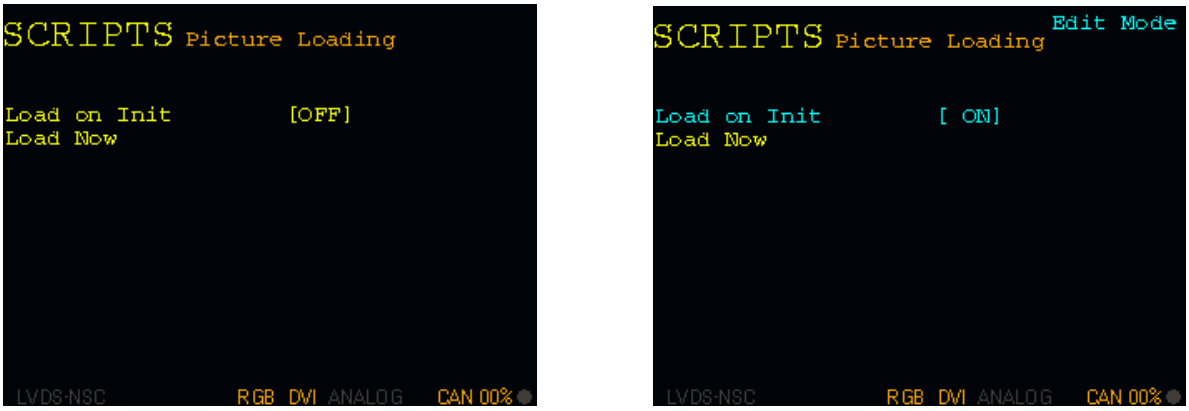


Figure 7.18. *Picture loading window in view and edit mode.*

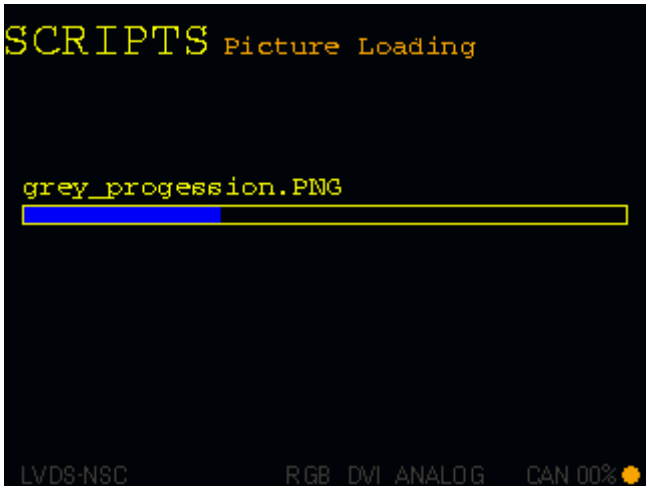


Figure 7.19. *Picture loading window progress.*

7.7 Menu B.1 PLOT

To access the PLOT sub menu from the top level menu, the user rotates MP until **"PLOT"** icon is selected as shown in next figure.

Figure 7.20. *PLOT TOP level menu selection*

7.8 Menu B.2 Timing

To access the Timing sub menu from the top level menu, the user rotates MP until **"TIMING"** icon is selected as shown in next figure.

Figure 7.21. *TIMING TOP level menu selection*

Once selected, pressing MP Button the system shall print on the screen the submenu related video timing. In this sub menu the system displays timing info on every channel. Rotating MP the timing info on every video channel is shown progressively. Pressing MP button makes the RESET string to appear on the TOP right corner of the screen. Pressing MP button again executes a reset on the corresponding measurement block. Pressing VM exits the reset mode. Pressing VM exits the Timing Sub menu.

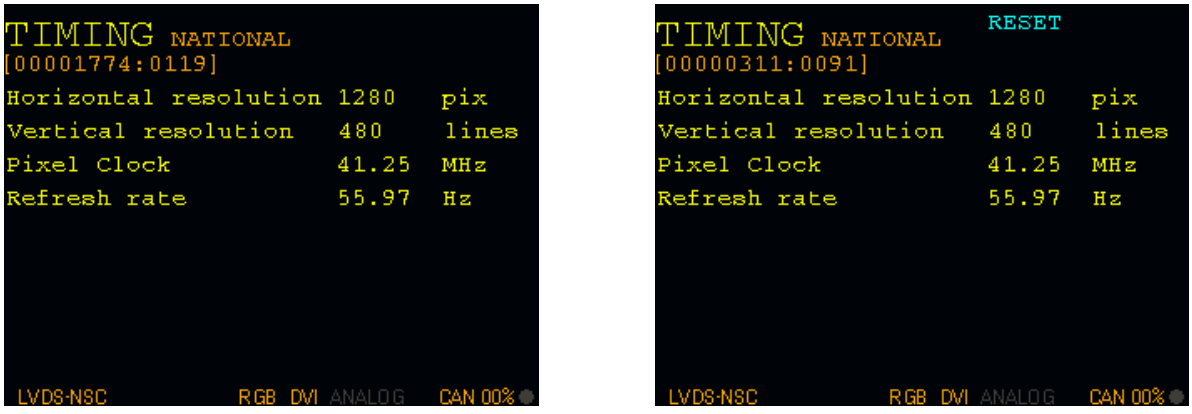


Figure 7.22. *TIMING Submenu on National video channel, normal and reset state.*

7.9 Menu B.3 BEM

To access the Bit Error Monitoring sub menu from the top level menu, the user rotates MP until **"BEM"** icon is selected as shown in next figure.

Figure 7.23. *BEM TOP level menu selection*

7.10 Menu B.4 CAN Bus

To access the CAN Bus sub menu from the top level menu, the user rotates MP until **"CAN BUS"** icon is selected as shown in next figure.

Figure 7.24. *CAN Bus TOP level menu selection*

Once selected, pressing MP Button the system shall print on the screen the submenu related to CAN Bus Setup. This submenu contains 5 windows, they are:

- *CAN Bus Setup Window*.

- *CAN trace Window*.
    - o *Select/Copy to TX Window*
- *CAN TX Frame Single*.
- *CAN TX Frame list.*

7.10.1 CAN Bus Set up window.

Displays and edits the following parameters:

- Trace Mode. Sets up the way the receiver gathers the input data on the CAN bus. Can be programmed as FULL list or DELTA list. In FULL list mode the system stores up to 1024 messages in a ring buffer together with a global time stamp. In DELTA list mode the system assigns each position of the CAN receiver ring buffer to a given ID storing the time between messages with the same ID and a 12 bit counter keeping track if the message occurrence with a given ID.
- Baud Rate. Sets up the baud rate of the CAN bus. The system supports, 10K, 20K, 50K, 100K, 125K, 250K, 500K, 800K and 1000K baud. The Baud rate can only be programmed when RX and TX routines are disabled.
- Enable TX. Enables or disables the TX routine. In this routine up 16 different user programmed CAN messages are sent by PROTON LVDS.
- Enable RX. Enables or disable the RX routine. This routine will gather the received CAN bus data on a ring buffer for later display on the CANBus trace window.

Next Figure shows the CAN Setup dialog window in view and edit modes.

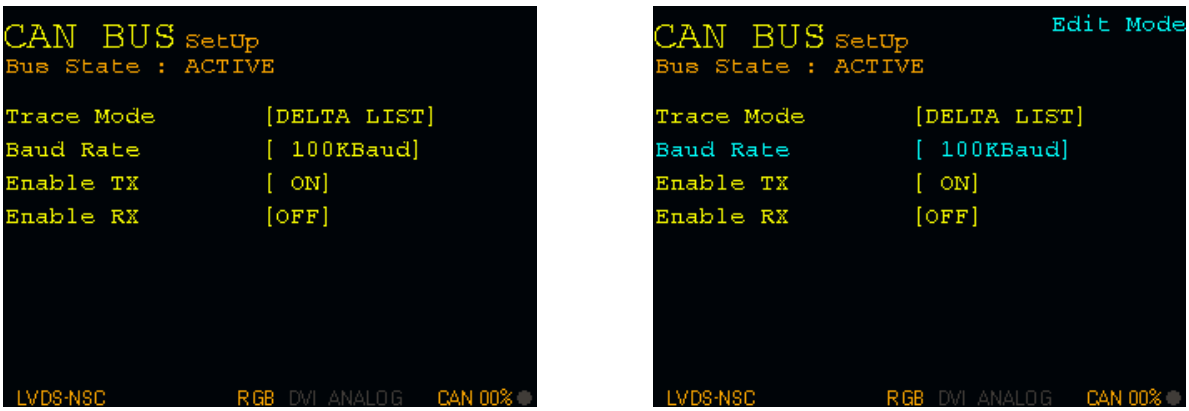


Figure 7.25. *CAN Bus TOP level menu selection*

To enter Edit mode press MP Button. To select a parameter (marked in CYAN) rotate MP. To change the selected parameter value, rotate VM. To exit the edit mode, press VM. To exit the CAN bus submenu press VM.

7.10.2 CAN Bus Trace window.

The CAN Bus trace window displays the received CAN messages in Delta or Full trace modes. Next figure shows a screenshot of both operating modes.

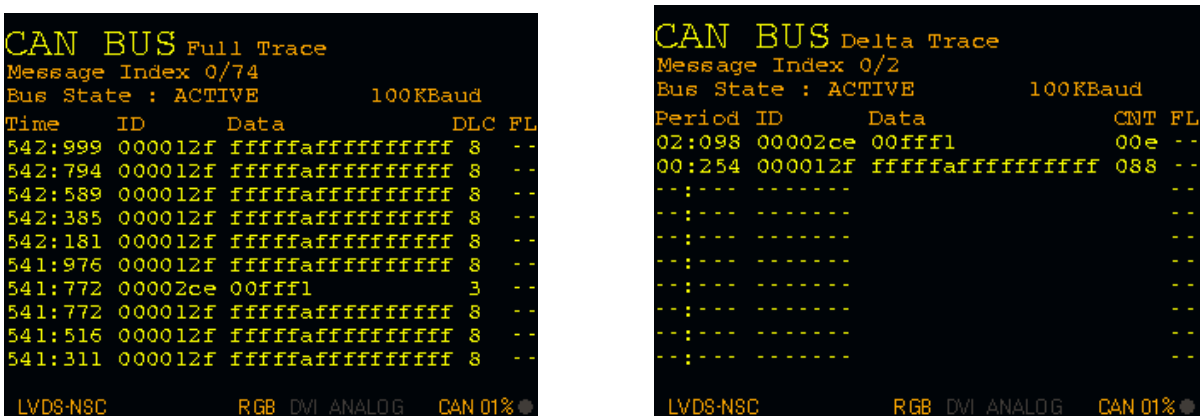


Figure 7.26. *CAN Bus Trace Window. Full Trace and Delta Trace.*

In Full List mode, the window displays up 10 messages from the 1024 message long RX ring buffer. Rotating VM, the user can select the position of the first message in this 10 message snapshot within the whole receiver buffer (1024 messages). The position of the first message can be viewed in the "Message Index" field. Once the message index is not zero the ring buffer functionality is disabled and whenever the receiver routine has 1024 messages accumulated stops logging data. In this way, the user can browse/search within these 1024 messages by rotating VM. Together with the message index field, the window displays the Bus state and the chosen baudrate.

In Full List mode, the trace window shows the following columns.

Column	Description
Time	Global time stamp expressed in seconds and milliseconds. *sec:mill.*
ID	Message ID.
Data	CAN frame data.

Column	Description
DLC	CAN frame data length.
FL	CAN Frame Flags, the first position is assigned to remote marking, the second position to Extended marking.

In Delta List mode, the trace window shows the following columns.

Column	Description
Period	Time between two messages with same ID. expressed in seconds and milliseconds. *sec:mil*
ID	Message ID.
Data	CAN frame data. The DLC is explicit on how the data is displayed on the screen.
CNT	Number of messages received with a given ID. Coded in hex with 12 bits.
FL	CAN Frame Flags, the first position is assigned to remote marking, the second position to Extended marking.

The edit mode of the CAN bus trace window is entering after pressing MP button. In this mode, the possible actions are displayed on the TOP right corner of the screen and can be selected rotating VM. Once an action is selected can be executed by pressing MP button or canceled by pressing MV button. The possible actions are:

- *Reset*. Resets the RX buffer and sets the message Index value to zero.
- *Start*. Starts the RX routine.
- *Stop*. Stops the RX routine.
- *Copy to TX*. Copies the RX buffer into a temporal message array and jumps to the Select/Copy to TX menu.

Next figure shows the trace window on FULL list and edit mode with COPY TO TX action selected.

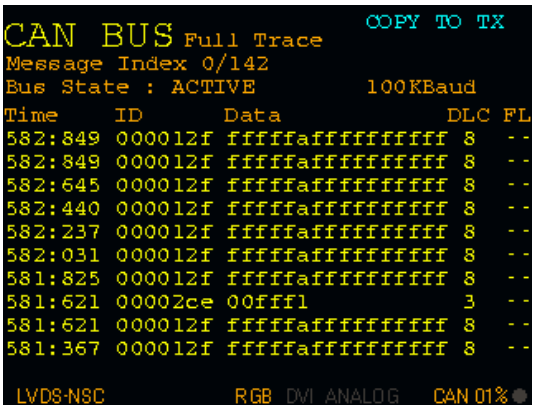


Figure 7.27. *CAN Bus Trace Window. Full Trace and edit mode.*

7.10.3 CAN Bus Select/Copy to TX Window.

This window displays 10 messages from up to 128 messages previously copied from RX buffer. Rotating MP the user can parse message after message through the whole list. The present parser list pointer marks the corresponding message with CYAN colour.

Rotating VM selects the action to be executed. The action is displayed on the TOP right corner of the screen on CYAN colour. Pressing MP executes the selected action. The possible actions are:

- *Select*. Selects the message which is marked on CYAN colour. A marked message is displayed in MAGENTA and has an x assign to it along the SEL column. See figure 7.28 as an example.
- *Select All*. Selects all the messages in the list.
- *Unselect All*. Deselects all the messages in the list.
- *Copy to TX*. Copies the selected messages (marked in MAGENTA colour) to the TX buffer. The selected messages will be taken as new TX messages if there is enough space in the TX Buffer and it's not write protected. The TX buffer can be write-protected independently for each can message. Returns to CAN bus trace window.
- *Cancel*. Returns to CAN bus trace window without executing any action.

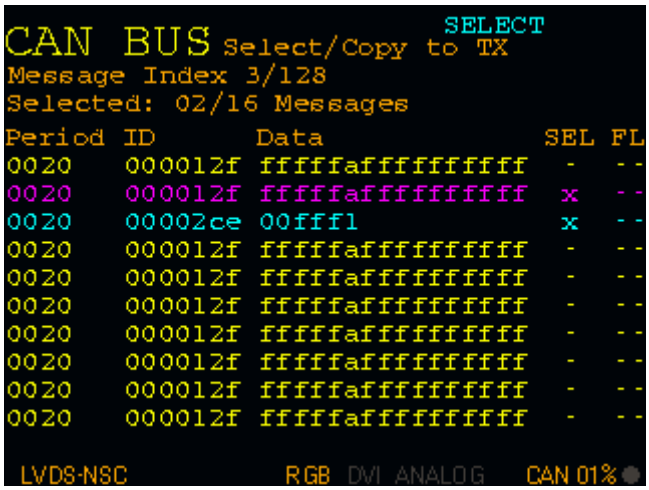


Figure 7.28. *CAN Bus Select/Copy to TX window.*

7.10.4 CAN bus TX frame single Window

This window displays the details on every single CAN message in the TX buffer. By rotating VM the user can jump between CAN messages in the TX buffer.

Pressing MP button the menu enters en edit mode. Once in edit mode (CYAN string in TOP right corner), the fields of the CAN message can be selected rotating MP. The selected field will be highlighted in CYAN colour. Rotating VM the value assigned to the selected field can be modified. Pressing VM the menu exits the edit mode.

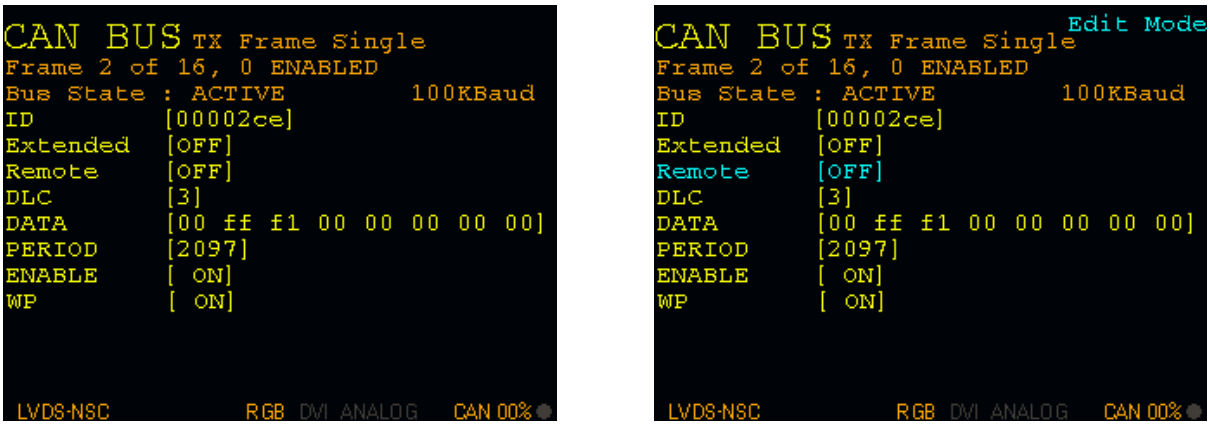


Figure 7.29. *CAN Bus TX frame single window, normal and edit modes.*

The editable fields on every CAN message are listed in the following table.

Field	Description
ID	CAN message ID. In edit mode, rotating VM the ID value is incremented or decremented in steps of 1.
Extended	CAN messaged extended Flag. In edit mode, rotating VM the flag toggle its

Field	Description
	value.
Remote	CAN messaged remote Flag. In edit mode, rotating VM the flag toggle its value.
DLC	CAN message data length. In edit mode, rotating VM the DLC value is incremented or decremented in steps of 1.
DATA	CAN message data. In edit mode, rotating VM every byte in the data field is incremented or decremented in steps of 1.
PERIOD	CAN message period. It is the value in milliseconds the CAN transmitter uses to generate cyclic messages. In edit mode, rotating VM the period value is incremented or decremented in steps of 1.
ENABLE	CAN message enable. This flag enables the sending of this message. In edit mode, rotating VM the message can be disabled/enabled.
WP	CAN message write protect flag. This flag is used internally in PROTON-LVDS during copy to TX process. When copying data from the RX buffer to TX buffer this flag prevents the message to be overwritten by new message.

7.10.5 CAN bus TX frame single Window

This window displays in compact form the messages in the TX buffer and theirs properties. Pressing MP button the menu enters edit mode. In edit mode a message can be selected by rotating MP and the actions to be performed are selected rotating VM. The supported actions under this menu:

- **ENABLE**. Enable/disable a single message in TX buffer. In edit mode and when ENABLE string is displayed in the TOP right corner of the screen. When a message is highlighted, pressing MP button enables and disables the selected message. An enabled message is marked with an ‘E’.
- **ENABLE ALL**. Enable all messages in TX buffer. In edit mode and when ENABLE ALL string is displayed in the TOP right corner of the screen. Pressing MP button enables all messages in the TX buffer. All messages will be then marked with an ‘E’.
- **DISABLE ALL**. Disable all messages in TX buffer. In edit mode and when DISABLE ALL string is displayed in the TOP right corner of the screen. Pressing MP button disables all messages in the TX buffer.
- **PROTECT**. Protect/unprotect a single message in TX Buffer. In edit mode and when PROTECT string is displayed in the TOP right corner of the screen. When a message is highlighted, pressing MP button protects and unprotects the selected message. A write protected message is marked with a ‘W’.

- **PROTECT ALL**. Protect all messages in TX buffer. In edit mode and when PROTECT ALL string is displayed in the TOP right corner of the screen. Pressing MP button protects all messages in the TX buffer for being overwritten. A write protected message is marked with a 'W'.
- **UNPROT. ALL**. Un protect all messages in TX buffer. In edit mode and when UNPROT. ALL string is displayed in the TOP right corner of the screen. Pressing MP button unprotects all messages in the TX buffer for being overwritten during copy to TX procedure.

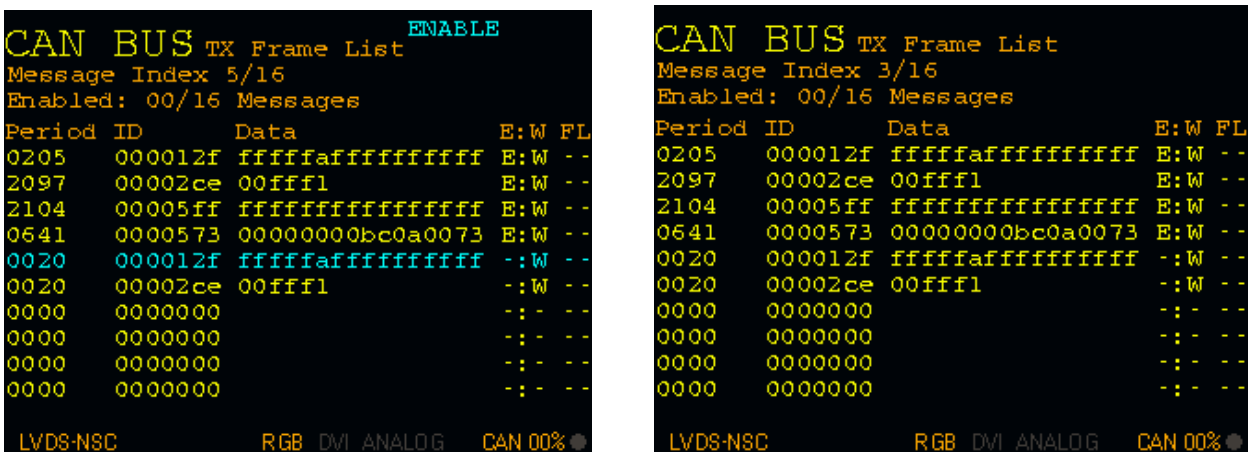


Figure 7.30. *CAN Bus TX frame list window, in normal and edit modes.*

7.11 Menu B.5 LVDS SETUP

To access the LVDS-SETUP sub menu from the top level menu, the user rotates MP until **"LVDS-SETUP"** icon is selected as shown in next figure.

Figure 7.31. *LVDS-SETUP TOP level menu selection.*

Once selected, pressing MP Button the system shall print on the screen the submenu related to LVDS-SETUP Setup. This submenu contains 4 windows selectable by rotating MP, they are:

- *NSC-RX*. Set up of National semiconductor receiver chip.
- *NSC-TX*. Set up of National semiconductor transmitter chip.
- *INOVA-RX*. Set up of INOVA receiver chip.
- *INOVA-TX.* Set up of INOVA transmitter chip.

Pressing MP button the menu enters the EDIT mode. Rotating MP, different fields are selected (marked in CYAN). Rotating VM, the selected parameter value is modified. Pressing VM button the menu leaves EDIT mode. Pressing VM the menu returns to top level menu. Next figures are shown LVDS-SETUP menu screenshots.

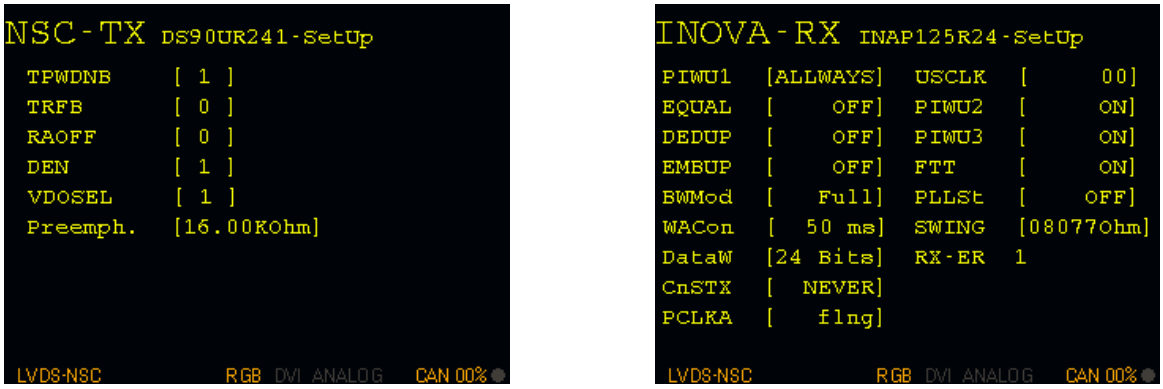


Figure 7.32. *LVDS-SETUP windows.*

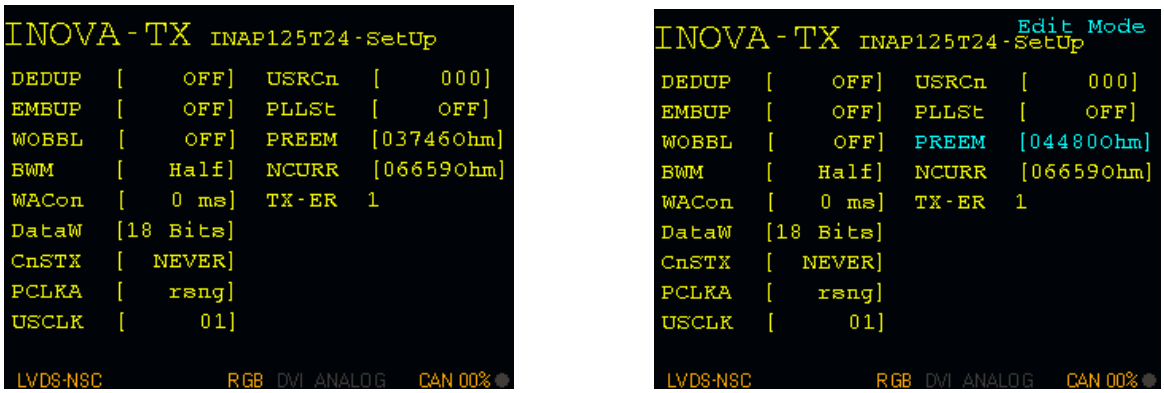


Figure 7.33. *LVDS-SETUP INOVA TX window, normal and edit mode.*

7.12 Menu B.6 Configs

To access the Configuration sub menu from the top level menu, the user rotates MP until **"Configs"** icon is selected as shown in next figure.

Figure 7.34. *Configs TOP level menu selection.*

Once selected, pressing MP Button the system shall print on the screen the submenu related to configuration files. This submenu contains only 1 window in which depending on where the CYAN cursor is located different actions can be performed.

- `Save to New/Save to Active`. If the cursor is located in the first row highlighting the string `Save to New` or `Save to Active`, when pressing MP button the present setup of the system will be saved into a new configuration file or overwrite the active configuration file (marked with a star). Rotating VM the user can select the action to execute: `Save to New` or `Save to Active`.
- `[*] config.som`. If the CYAN cursor is highlighting the name of a configuration file (`*.som`), pressing MP the selected configuration file is loaded and the system variables are initialized wit the contents of the file. The new file marked with a star `[*]` will be used a start up configuration file.

Next figure show Config Files menu screenshots 9 different configuration file are listed. In this example, `session_8.som` file is set as default configuration file.

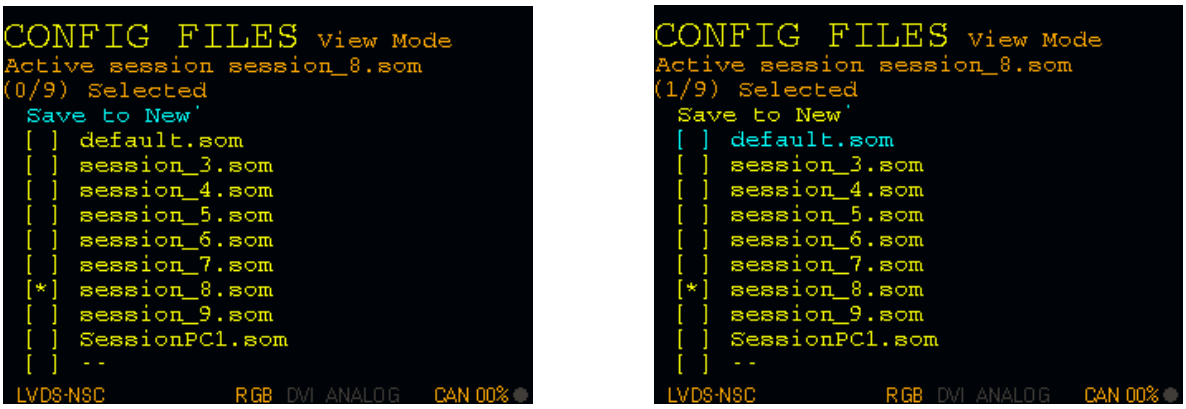


Figure 7.35. *Configs Window.*