MICROTRONIX
DX-2200
SD/HD-SDI TEXT & GRAPHIC INSERTER

USER MANUAL – VERSION 1.91

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DX-2200 SD/HD-SDI Text & Graphics Inserter User Manual

Document Revision History

This User Manual provides operating instructions and information on the following Microtronix products:

- DX-2200 – SD/HD-SDI Text & Graphic Inserter with Loop Output, (Model PN: DX-2200-TI-14) and
- DX-2200 – SD/HD-SDI Text & Graphic Inserter with PIP & Loop Output, (Model PN: DX-2200-TI-24.

The following table shows the document revision history.

Date	Rev.	Description
Jan 30, 2014	1.00	Initial release
Mar 10, 2014	1.10	Changed the Text Overlay to support both text and graphics Added two additional overlay layers Added L commands for enhanced layer control Added G commands to control graphics layers Added capability to update device firmware through RS232 port. Remove S0, S1, ST commands. Use L1D, L1E, L1V commands instead. Added more S commands to support same functions as the G commands
Jun 10, 2014	1.20	Added the capability to receive an RGB image with transparency uploaded over RS232, store images in flash memory, and display them on the overlay. Fix a problem that caused graphics to be skewed for some overlay sizes.
July 21, 2014	1.21	Add wingdings font table
Oct 16, 2014	1.23	Add 13 extended UTF8 characters to the Tahoma fonts
Nov14, 2014	1.31	Fonts and images are loaded on first use to make the DX-2200 start faster Added graphic field type 6 – rectangle specified by top/left and width/height Enhanced the Layer commands to specify more than one layer Increase number of graphic/text fields per layer to 48 Add commands MA0, MA1 to control ancillary data pass through Add commands to restrict rectangle fill width to a set width around the interior Add L1A and L1H commands to disable unused layers Enhance GnnX, GnnY to accept one or two parameters Add MB command to change baud rate Add support for Rev E PCB.
Dec 15, 2014	1.32	Add information on the image transparency and background color/transparency Fix an image background color problem. Fix a range check problem with the L commands Add illegal code remapping
Jun 03, 2015	1.40	Add additional Tahoma fonts Add capability for G and S commands to operate on a range of fields Add S/GnnNm and S/GnnJmm commands.

		Update drawing showing new enclosure with SD/HD-SDI Loop Output port
Jun 15, 2015	1.42	Add Tahoma 48 pixel font and Bitstream Vera Sans Mono
Oct 20, 2015	1.50	Add Mode 2 that uses the second input connector as a dedicated PiP input
Dec. 14, 2015	1.51	Update pictures of enclosure.
Feb. 26, 2016	1.60	Add mode 3, text inserter with scaling and associated ZS and B commands. Add ZP commands for text inserter with PiP (mode 2).
Mar 07, 2016	1.61	Add font 44, Vera Sans Mono Bold, 256 pixel height.
Nov 17, 2016	1.62	Add Commands RI1, RI2, RS1, RS2 for reporting input video resolution
Jan 17, 2016	1.65	Change factory default settings for the DIP switch. Add PiP position presets P5, P6, P7, P8 Add U2 command Fix a problem with SD video support Correct a problem with the TD command
July 19, 2017	1.67	Add an additional arrow character to the Wingding fonts at code 005F
Aug 23, 2017	1.68	Added configuration bypass function
Nov 13, 2017	1.70	Modified the configuration bypass function to also bypass loading of images from flash memory. Improve handling of corrupted images in the flash memory. Fix a bug in the frame counter when using 1000/1001 frame rates Add a time clock mode to the frame counter display Add support for capture of NMEA 0183 GPS data from the DB9 serial port and insertion of selected parameters into text fields for display on the overlay.
Feb. 6, 2018	1.71	Added section outlining Serial Port Communication Added section numbering to document layout
Mar. 21, 2018	1.75	Updated Tahoma 18 regular font to correct a character spacing issue
Dec. 6, 2018	1.75	Minor typographical corrections. Improved cross referencing.
Apr. 16, 2019	1.76	Correct G0Z command description to show that is clears fields on all layers.
Apr. 24, 2019	1.80	Added new status reporting commands as listed in Appendix C.
Aug. 21, 2019	1.90	Added the OM command to the manual. Added Modes 4, 5 that provide low frame delay on SDI Input 1. See § 4.5 and § 4.8.1.4
Sep.10, 2019	1.91	Add alpha keying function for the PiP input. See § 4.8.1.8 Add RO command to report output mode. See Table 23 Add P9 command for center screen PiP position. See Table 7: PiP Control Serial Command CodesTable 7

NOTE: The graphics overlay feature requires the use of the ***DX-2200 Software Uploader*** utility which is used to upload graphic images into the unit. Contact *support@microtronix.com* for the latest release of the DX-2200 firmware and the Software Uploader utility.

How to Contact Microtronix

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Sales Information: sales@microtronix.com

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Product Design Customizations

Microtronix can customize the functionality of the **SD/HD-SDI Text & Graphic Inserter** software to customer requirements. Contact Microtronix sales (sales@microtronix.com) with your requirements.

Safety Critical & Life System Applications – Notice to User

The Microtronix DX-2200 SDI Video Products are not designed or approved by Microtronix for use in **safety-critical** or **life-critical system** or application in which a failure or malfunction may result in one (or more) of the following outcomes: (a) death or serious injury to people, (b) loss or severe damage to equipment/property, or (c) environmental harm.

Microtronix assumes **no liability** for any consequential damages – whether direct or indirect – if the product is used in this type of application.

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1   Key Product Features

The key hardware features of the base *DX-2200 – SD/HD-SDI Text & Graphics Inserter with Loop Output* (Model PN: DX-2200-TI-14) product includes:

- One 75Ω SD/HD-SDI input port
- Two 75Ω SD/HD-SDI output ports
- One for overlay output
- One for loop-though output
- One DB9 RS-232 Serial Control Port

The *DX-2200 – Text & Graphic Inserter with PIP & Loop Output,* (Model PN: DX-2200-TI-24) product variant has an additional 75Ω SD/HD-SDI input port.

1.1   Supported Functionality

- Video Input formats:
  o   NTSC @ 29.97 fps (frames per second)
  o   PAL @ 25 fps
  o   720p @ 25 / 29.97 / 30 / 50 / 59.94 / 60 fps
  o   1080i @ 25 / 29.97 / 30 fps
  o   1080p @ 23.98 / 24 / 25 / 29.97 / 30 fps
  o   1080psf @ 23.98 / 24 / 25 / 29.97 / 30 fps
- Video Output automatically adjusts to match the input video format
- Ancillary data from the video input is preserved to provide pass-through of audio, closed captions and other metadata on the main SDI input
- Text and Graphics Overlay OSD:
- Three overlay layers
- Up to 48 independent text or graphic Fields per layer
- Fields support text, rectangle, corner markers, target marker, and graphic images.
- Filled or open rectangles
- Size, color, transparency and position control
- Configurable background color for text
- Alpha blended text and background
- Alpha blending of graphic components
- Frame Counter text overlay display
- Five modes of operation:
  o   Mode 1 = Text Inserter,
  o   Mode 2 = Text Inserter with PiP using SDI Input 2 as PiP source*,
  o   Mode 3 = Text Inserter with Scaling,
  o   Mode 4 = Low Frame Delay Text Inserter,
  o   Mode 5 = Low Frame Delay Text Inserter with PiP using SDI Input 2 as PiP source*
- Output video clock frequency locked to input
- Low video frame delay
- User defined operation of DIP & Toggle switches
- Flash storage of user configuration and text fields for auto system recovery after power-off

- 2MB of flash for storage of graphic images
- Firmware update over RS232 Serial Port

1.2   Product Package Contents

The ***SD/HD-SDI Text & Graphics Inserter*** product package includes the following items:

- SD/HD-SDI Text & Graphics Inserter with Loop Output, Model PN: DX-2200-TI-14, or
- SD/HD-SDI Text & Graphics Inserter with PIP and Loop Output, Model PN: DX-2200-TI-24,
- 100-240VAC – 12VDC, 1.3A Power Adapter, PN: 589-PS-1213AP,
- USB 2.0 to RS-232 DB9 Serial Adapter Kit, PN: **8121-USB-RS232-KIT**,
- User Manual on CD

2   Introduction

The Microtronix *DX-2200 – SD/HD-SDI Text & Graphics Inserter* is a high performance single input video text and graphics inserter supporting alpha blended text and graphics overlay / on screen display (OSD) on progressive, psf and interlaced SD and HD video formats. With support for embedded audio, VBI content and metadata, it is designed for use in broadcast, professional video recording studios, high-end surveillance applications and Point-of-Sale security systems requiring live insertion of high quality text streams onto a SDI video signal.

The unit auto detects the format of the input video and outputs in the same format. Custom user configurations and parameters can be stored in on-board flash for auto restoration during power ON/OFF cycles. A fail-safe buffered SD/HD-SDI Loop Output is available for passing through the input signal unmodified as may be required for broadcast applications.

2.1   Text and Graphics Overlay OSD Features

Features of the overlay OSD include:

- Three layers for text and graphics fields
- Display of 48 independent fields per layer
- Fields support Text, Rectangles, Corner Markers, Target Marker and Image modes
- Text Field of up to 195 characters
- Alpha blending of the text for smooth edges
- Frame Counter on the top overlay layer
- Independent color selection of fields
- Configurable background color of text fields
- Transparency control
- Independent ON/OFF control of fields
- X-Y position control
- Permanent retention of text fields in flash memory
- PIP of auxiliary SD/HD-SDI input (product variant option)

The text and graphics are supplied to the DX-2200-TI through the RS-232 serial port. The user can optionally store the text fields in the on-board flash in which case they will be retained power ON/OFF power cycles.

3   Hardware

The *SD/HD-SDI Text & Graphics Inserter* is available as a stand-alone product supplied in an enclosure as show in Figure 1 and Figure 2 below, or optionally as an open-frame board (for building into embedded video system) as shown in Figure 26 in Appendix A: Internal Circuit Board Description.

Figure 1: DX-2200-TI-14 – SD/HD-SDI Text & Graphics Inserter with SDI Loop Output

Figure 2: DX-2200-TI-24 – SD/HD-SDI Text & Graphics Inserter with PIP and SDI Loop Output

3.1   Power Requirements

The DX-2200-TI product is powered from either a 5 – 12Vdc 10W (100-240VAC 50/60Hz) regulated switching power adapter with a 2-pin circular plug (female) connector (Switchcraft PN: 16282-2SG-311), or optionally from a 14.4V Lithium ion brick battery.

3.1.1   AC Power Adapter

The DX-2200-TI unit has a current draw of 650mA when operating from at 12VDC regulated power source.

A picture of the AC power adapter is shown in the figure below.

Figure 3: 12Vdc 1.33A 100-240VAC Power Adapter
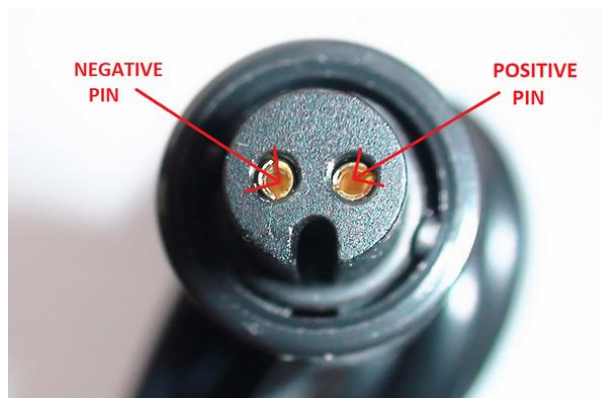
Figure 4: Pin Assignments of 2-pin Power Plug

3.1.2   Example of 14.4VDC Lithium Battery

A picture of a 14.4VDC the AC power adapter is shown in the figure below.

Figure 5: 14.4VDC Lithium Batter and D-TAP Cable

Microtronix does not sell Lithium Ion batteries. The 14.4VDC D-TAP adapter cable (shown in the figure above) can be ordered using Microtronix part number D-TAP-2P-C.

3.2 Environmental Operating Limits

The DX-2200 unit uses passive convection cooling based on unrestricted airflow around the unit. The environmental operating limits are as follows:

        Ambient Temperature Range: 0C to 40C
        Relative Humidity: 0 to 95% non-condensing.

4 Operation

4.1 Default Startup Configuration

The factory default configuration for the DX-2200-TI has no saved configuration in flash and the following DIP switch settings:

Table 1: Default DIP Switch Settings

DIP Switch	Setting
1	Off
2	Off
3	Off
4	Off

When powered up in the factory default configuration, the unit will pass the input video through to the output with no text overlay items added. The DX-2200-TI will automatically output in the same video format as is detected at the input.

If there is no input signal (or if it cannot be properly detected), the SDI output will display black and the video format will be 720p @ 60 fps.

A user specific setup can be stored in flash to enable the DX-2200-TI to start in a different configuration, for example with a text overlay displayed.

4.2 LED Status Indicators

The location of the 5 LEDs is show in the following figures.

Figure 6: SDI Outputs & Status LEDs
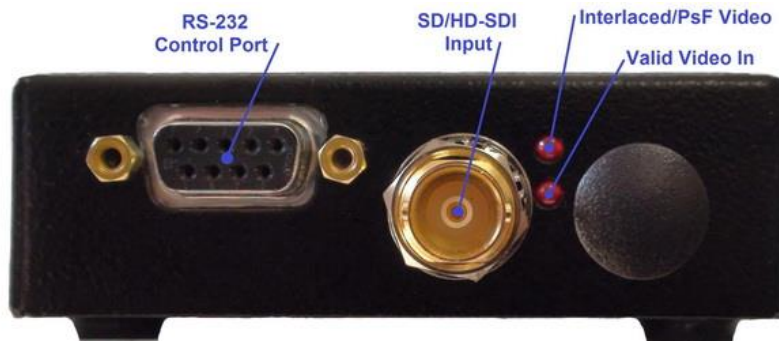
Figure 7: SDI Input & Status LEDs
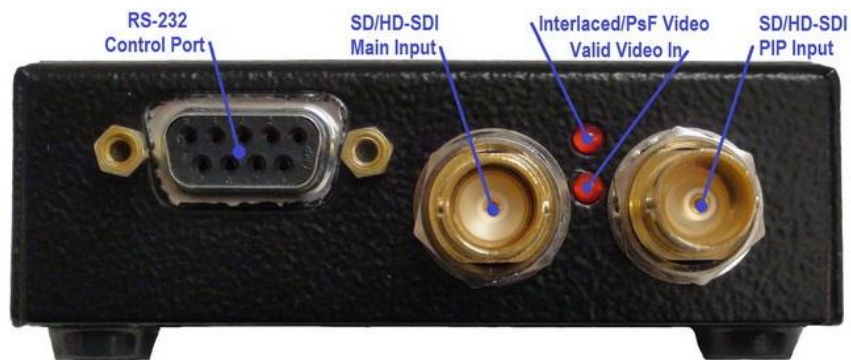
Figure 8: SDI Inputs & Status LEDs (PIP product model)

The operation of the status LEDs is summarized in Table 2 below.

Table 2: Description of LED Status Indicators

LED	Color	Use	Mode of Operation
Input-Top (Board D4)	Red	Interlaced / PsF Video Detected	OFF: The SDI input video is a progressive video format. ON: The SDI input video is either an interlaced or PsF video format.
Input-Bottom (Board D4)	Red	Valid Video	OFF: The SDI input has either no video, or an unsupported video format. ON: A signal is detected on the input.
Output (Board D4)	Green	Power	ON: Power OK
Output-Top (Board D5)	Red	Output On	OFF: SDI output is not enabled. ON: The SDI output is enabled.
Output-Bottom (Board D5)	Red	Clock Frequency Lock	OFF: The output video clock is free running. ON: The output video clock is frequency locked to the input video clock.

4.3   Video Format

The default video format is 720p @ 60 fps. If no input signal is connected at power-up (when operating in the factory default configuration) the DX-2200-TI will output a black screen. The Text Overlay can be used without input video connected.

When an SDI input with one of the supported video formats is connected, the unit will detect the video format and switch the output to the match the detected video and attempt to lock to the clock frequency of the video input. The video output will momentarily switch off as the video output is adjusted to match the format and clock frequency of the input. When the clock frequency is locked, the video path is enabled and the input video and ancillary data will appear at the output.

If the SDI input is disconnected, the unit continues to output in the last video format that was detected.

The default output video format can be changed by saving the configuration when the unit is operating with the desired output format, or by using the Default Video Format command (OM) to set a different mode.

4.4   Picture-in-Picture (PiP)

Units equipped with the optional second SDI input connector (Input 2) are capable of PiP display using the second SDI Input as the PiP source. The PiP video source can be asynchronous to the main video input or can be a different resolution / frame rate. If the main input is an interlaced format, the PiP input must be interlaced, and if the main input is a progressive format, the PiP input must be progressive. The size and position of the PiP is programmable by software commands.

The PiP input will only function after the background video has been connected to Input 1. The PiP input does not support audio or other ancillary data types. For interlaced formats, connection of a signal to the PiP input may create an output video glitch as the unit synchronizes to the input.

4.5   Video Buffering and Frame Delay

For Text Inserter Mode (Mode 1) and Text Inserter with PiP (Mode 2), input 1 has a delay of approximately 1 frame. Input 2 (used for PiP) has a delay of between 1 and 2 frames. This delay will vary depending on the alignment of the PiP source relative to the input 1 source.

For Text Inserter with Scaling Mode (Mode 3), the DX-2200-TI has approximately 2 frames of delay.

In the Low Delay Modes (Mode 4 & 5) the delay from input 1 to the output is approximately 100 us is HD modes and 500 us in SD modes. The PiP input has a delay of between 1 and 2 frames and this delay will vary depending on the alignment of the PiP source relative to the input 1.

Note: Refer to section for more information.

4.6   Audio and Ancillary Data

The DX-2200-TI preserves ancillary data in the main SDI Input (Input 1) and passes it through to the output to provide pass-through of audio, closed captions, and other ancillary data types embedded in the SDI video.

The optional PiP SDI Input (Input 2) does not support audio or other ancillary data types.

4.7 OSD Layers

The DX-2200-TI supports three video layers that are mixed on top of the SDI video input(s).
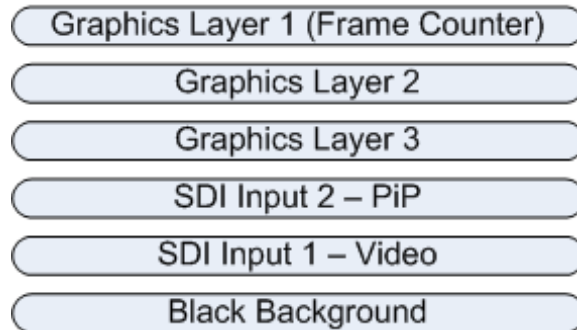
Figure 9: DX-2200-TI Layer Order

The top layer in the mix is referred to as *Graphics Text Layer 1.* This layer displays up to 48 Fields that support text and graphics. The optional Frame Counter displays on this layer. Text Fields on this layer are configured using either the Text Overlay Serial Commands or the Graphics Overlay Serial Commands. The Frame Counter is configured by the Frame Counter Serial Commands.

The next two layers are *Graphics Layer 2* and *Graphics Layer 3*. These layers each display up to 48 display Graphic Fields that are controlled by the Graphic Overlay Serial Commands.

The 4th layer is the *SDI video*, and the 5th layer is the *Black Background.*

Within any one layer, no mixing of fields takes place. If two fields have pixels that occupy the same coordinates, one will overwrite the other. When an update is performed to render the fields on a layer, the fields are rendered in order of their field number. For example, Field 4 will always be rendered after Field 3 and will overwrite any pixels of Field 3 if they are in the same location in the frame.

When graphic fields on different layers are placed at the same coordinates, they mix according to their transparencies and the layer order. When a field is fully visible, no content that is on the layers below it will be visible. When the field is partly or fully transparent, it mixes with the layers below according to their transparencies.

4.8 SERIAL & MANUAL Control

The SD/HD-SDI Video Text Inserter has two methods of control: SERIAL Control using the RS232 port, and MANUAL Control using the DIP switch and Toggle switch. SERIAL Control allows control full of the capabilities of the DX-2200-TI, and MANUAL Control provides a subset of functions.

SERIAL Control is always active. In the factory default configuration the Toggle Switch and DIP switch are active.

The functions of the DIP switch and Toggle switch can be reconfigured by SERIAL Control commands to customize the Switcher so that the controls provide the set of functions required for a specific user application. The modified configuration can be saved on board in the flash configuration memory.

4.8.1 SERIAL Mode of Operation

When SERIAL control is used, the DX-2200-TI is controlled via commands sent to the DB9 Serial Control Port.

The serial COM port of the computer connected to the DX-2200-TI should be configured for: 115,200 baud, 1 stop bit, and no flow control.

4.8.1.1 USB 2.0 to RS-232 Serial Port Adapter

The DX-2200 product is supplied with a **USB 2.0 to DB9 RS-232 Serial Port Adapter Kit** (PN: 811-USB-RS232 Kit) to connect the DB9F Serial Port to a USB 2.0 port of a PC or laptop. The Kit consists of a USB 2.0 to RS232 DB9 Serial Adapter Cable (StarTech PN: ICUSB232V2) and a 6 foot male to female DB9 RS232 serial cable. Refer to Appendix B: USB to RS-232 Serial Port Adapter for more information.

4.8.1.2 DX-2200 Serial Port Control Commands

In the SERIAL mode, commands sent to the Serial Control Port control the operation of the DX-2200-TI. Commands consist of ASCII alpha-numeric codes and are not case sensitive. All Serial Commands are terminated with a carriage return (CR), a line feed (LF), or a semicolon. The use of a semicolon terminator allows more than 1 command per line to improve readability of script files.

Commands may be sent directly to the DX-2200-TI one character at a time using a terminal program running on a connected computer, or they may be developed in a text editor such as Notepad and then uploaded to the DX-2200-TI by the terminal program. The second method has the advantage of allowing the commands to be saved, viewed, edited and resent. The text editor used must save the configuration files as 8 bit ASCII data.

Space or tab characters before a command or trailing a command are ignored, as are spaces or tabs following a comma that separates parameters within a command. Any characters on a line following a tick (') character are treated as comments. A comment may begin after a delimiter, or may follow a command with or without spaces or tabs between the command and the comment.

ASCII string parameters are delimited with quotation marks. If a quotation mark or backslash character is required within a string (for example to display as part of a text overlay), then it must be preceded by a backslash character.

Valid and invalid Serial Commands are acknowledged with a '+' and '-' response respectively. Carriage return, line feed, or semicolon characters without a preceding command are acknowledged with a '*'.

The command codes are extensible, additional commands and functionality can be added as required. Contact Microtronix sales or technical support with your requirements.

Table 3: Serial Port Command Acknowledgement Codes

Response Code	Mode of Operation
+	Valid command received
-	Invalid command received
*	Valid CR, LF, semicolon, or comment line received

4.8.1.3 Input Video Transparency SERIAL Command

The Input Video Transparency Commands set the transparency of the input 1 SDI video. By default the, the SDI input video has no transparency. By using these commands, the input video can be made partially transparent so that the black background layer becomes visible.

Table 4: Transparency SERIAL Command Codes

Command Code	Mode of Operation
An – Set transparency of the SDI input 1 video	
A0	0% transparency

A1	12.5% transparency
A2	25% transparency
A3	37.5% transparency
A4	50% transparency
A5	62.5% transparency
A6	75% transparency
A7	87.5% transparency
A8	100% transparency
Annn	Set the transparency with higher resolution where nnn – is a three digit number between 000 and 255 where 000 is 0% transparent and 255 is 100% transparent

4.8.1.4 Mode Control SERIAL Command

The Mode Control SERIAL Command selects an operating mode for the product and are listed in Table 5 below. Changing the mode can be used to switch the PiP on and off. Switching between modes 1 & 2, and switching between modes 4 & 5 is fast and does not disrupt the video. Any other mode changes will stop and restart the video.

Table 5: Mode Control SERIAL Command Codes

Command Code	Mode of Operation
M1	Text Inserter
M2	Text Inserter with PiP using Input 2 as the PiP source. PiP will only activate if a valid video input is present at Input 2.
M3	Text Inserter with Scaling.
M4	Low Frame Delay Text Inserter. The video path does not include a frame buffer and has an input to output delay of approximately 100 us. The low delay mode only outputs video when a video input is present at input 1.
M5	Low Frame Delay Text Inserter with PiP. The input 1 video path does not include a frame buffer and has an input to output delay of approximately 100 us. The low delay mode only outputs video when a video source is connected to input 1.

4.8.1.5 Ancillary Data SERIAL Commands

By default, the DX-2200-TI preserves all ancillary data in the video signal. It is possible to control this function if the ancillary data is not required. Disabling the ancillary data may slightly increase graphic update speed in some situations.

Table 6: Ancillary Data Control SERIAL Command Codes

Command Code	Mode of Operation
MA0	Disable ancillary data pass through
MA1	Enable ancillary data pass through

4.8.1.6 Baud Rate SERIAL Command

The DX-2200-TI always powers up at 115200 baud. After power up, the baud rate can be changed using the MBnnnnnnn command, where nnnnnnn is the new baud rate between 9600 and 1000000 baud.

The response to the baud rate command is transmitted before the baud rate is changed. It is recommended to wait 100 ms after receiving the response before sending commands at the new baud rate to ensure the DX-2200-TI is ready to receive commands at the new rate.

NOTE: The DX-2200-TI always starts at 115200 baud. Changes to the baud rate cannot be saved to flash.

Table 7: Baud Rate SERIAL Command Codes

Command Code	Mode of Operation
MBnnnnnnn	Set the baud rate to nnnnnnn where nnnnnnn is a number between 9600 and 1000000 baud.

4.8.1.7 Default Video Format Command

The Default Video Format command sets the video format that is output by the DX-2200 at start up when there is no input signal present on input 1. This is only applicable to Mode 1 (Text Inserter), Mode 2 (Text Inserter with PiP) and Mode 3 (Text Inserter with Scaling). The Low Delay modes of operation (Mode 4 & 5) do not output any video when the input 1 source is not present).

When video is connected to input 1, the DX-2200 will switch modes to match the input and remain in the detected mode if the signal is removed.

Table 6: Default Video Format Command Codes

Command Code	Mode of Operation
	Video Format Selection
OMxxx	Selects the default Video Mode that is used at startup when no input signal is detected on input 1. Where xxx determines the video format as follows: 000 – Use product default 012 – 720p @ 25 fps 013 – 720p @ 29.97 fps 014 – 720p @ 30 fps 015 – 720p @ 50 fps 016 – 720p @ 59.94 fps 017 – 720p @ 60 fps 030 – 1080p @ 23.98 fps 031 – 1080p @ 24 fps 032 – 1080p @ 25 fps 033 – 1080p @ 29.97 fps 034 – 1080p @ 30 fps 040 – NTSC 720x487 @ 59.97 fields per second

	041 – PAL 720 x 576 @ 50 fields per second
	050 – PsF 1080 / 23.98 fps
	051 – PsF 1080 / 24 fps
	052 – 1080i @ 25 fps and PsF 1080 / 25 fps
	053 – 1080i @ 29.97 fps and PsF 1080 / 29.97 fps
	054 – 1080i @ 30 fps and PsF 1080 / 30 fps

4.8.1.8 Picture-in-Picture Position, Size, Alpha, and Zoom SERIAL Commands

These commands apply only to the Text Inserter with PiP modes of operation (Mode 2 & 5, see the Mode Control Serial Commands).

The position and size of the Picture-in-Picture (PiP) display is selected through character commands sent via the RS-232 port per Table 7 below.

There are two different methods of controlling the PiP size and position. The first method selects one of four predefined positions and one of 16 predefined sizes using the commands PSnn, PAxxxx, PByyyy, followed by P3, P4, P5, P6, P7, or P8 to set the positions and apply the settings.

For example: PiP in the bottom right corner using control method 1:

PS04	' Set PiP size to be 4/16ths of the video width
PA20	' Offset PiP 20 pixels horizontally from edge of the video
PB20	' Offset PiP 20 pixels vertically from the edge of the video
P2	' Apply settings and place PiP in bottom right corner

If the PS, PA, or PB commands are omitted in the above example, the previous setting, or the default will apply. The default size for the PiP window is $6/16^{th}$ of the video width (equivalent to the command PS06). The default horizontal and vertical offset is 1 pixel + 1% of the screen width. If the P2 command is omitted there will be no visible change to the PiP because it is this command that applies the parameters set the other commands in the example.

The second method of setting PiP size and position does not use predefined sizes or positions, instead the width, height, and the x and y position of the top left corner are set in terms of number of pixels by using the commands PWxxxx, PHyyyy, PXxxxx, PYyyyy, followed by either PU or PR to apply the settings.

For example: PiP configured using method 2:

PX100	' Set Top Left corner of PiP to x=100 pixels from the left
PY400	' Set Top Left corner of PiP to y=400 pixels from the top
PW711	' PiP window width = 711 pixels
PH400	' PiP window height = 400 pixels
PU	' Apply the PiP Settings

This control method allows the aspect ratio of the PiP window to be changed, possibly resulting in stretched or compressed video in the PiP window. If the PR command is used instead of the PU command, the height parameter set for the PiP window by the PH command is ignored, and a value is calculated from the width to provide a 16:9 aspect ratio for the PiP window.

In all cases, the PiP window must fit within the video. It is not possible to place the PiP window partly or fully off screen. The DX-2200 will automatically adjust the gap, position and size parameters as needed to force the PiP window to fit on screen. The minimum PiP width and height is 32 pixels. The DX-2200 will automatically adjust the size to prevent the PiP windows being smaller than this size.

The PiP supports a limited zoom / cropping function that allows a selected region of the PiP video source to be overlaid on the main channel instead of the entire frame. Two modes for selecting a region of the frame are provided. The first method is controlled by a zoom factor specified in percent and a center location for the zoom. The second method selects the top and left edge of the region, and the width and height. These functions do not upscale the PiP input source. At most, each input pixel can generate 1 output pixel. The DX-2200 automatically limits the values of the command parameters if the requested settings exceed the valid ranges, for example by calling for magnification of the source.

The PiP input supports three alpha modes. In constant alpha mode (set by the command AFM0), the entire PiP window has the same transparency and this is set by the AFn commands. The other two modes operate based on a defined color range. In the visible range mode ("AFM1"), the selected range of colors has the transparency set by the AFn commands, and the other colors have transparency set by the AFXn commands (by default, these are totally transparent). In the transparent range mode (AFM2) the selected range of colors has a transparency set by the AFXn commands, and the other colors have transparency set by the AFn commands.

The typical usage case is shown below. A computer-generated overlay with a black background is connected to the PiP input with the PiP size is set to full screen. The alpha mode is set to transparent range, with black defined to be the transparent color. Only the non-black parts of the overlay will be visible on the output video.

The commands to configure the DX-2200 for this operation are shown below. The example includes more commands than are strictly necessary because the default color selection is black when the product is at factory default configuration, but the extra commands are included to make the example more explanatory.

```
AFM2                ' alpha mode set for transparent range
AFCB510,514         ' set lower/upper color range for Chroma Blue
AFCR510,514         ' set lower/upper color range for Chroma Red
AFY0,80             ' set lower/upper color range for Luma
PS16                ' set the PiP to full screen
AF0                 ' make the non-selected pixels fully visible
AFX8                ' make the selected pixels fully transparent
```
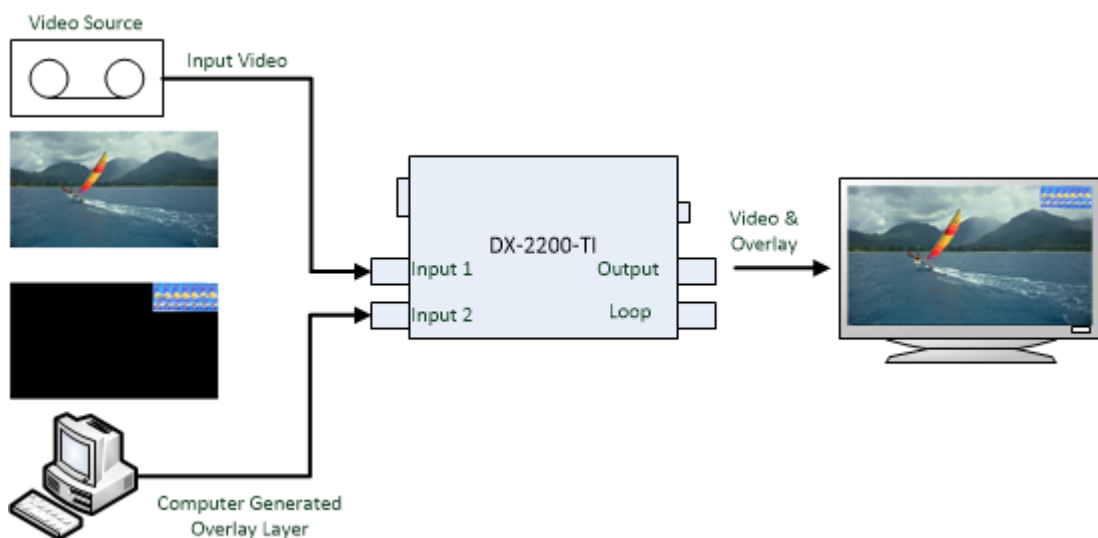

Figure 10: Example of Computer-Generated Graphics Overlay with Transparency

The selected color range can be specified in two different ways; either in native YCbCr color space using the commands AFCR, AFCB and AFY commands to specify lower and upper color range, or in RGB color space

by using the AFR, AFG and AFB commands to set the color and the AFA command to set a range of color around that center point that will be selected. The AFC0 or AFC1 command is used to specify which of the color spaces is being used to select the colors.

The product default is to use the YCbCr color space, with the default selection color as black. Color selection will typically require a trial and error process to find the optimal color ranges when colors other than black are being used.

Table 7: PiP Control Serial Command Codes

Command Code	Mode of Operation
P1	PiP upper right with preset size
P2	PiP lower right with preset size
P3	PiP upper left with preset size
P4	PiP lower left with preset size
P5	PiP top center with preset size
P6	PiP bottom center with preset size
P7	PiP center left with preset size
P8	PiP center right with preset size
P9	PiP center with preset size
PSnn	Set the PiP size used with the predefined PiP positions. The width is set in units of 16ths of the output video width. For example PS05 set the width to 5/16ths of the video width.
PAxxxx	Set the horizontal gap in pixels between the reference corner and the Pip window when using the predefined PiP positions. Enter the value 9999 to use the default.
PByyyy	Set the vertical gap in pixels between the reference corner and the Pip window when using the predefined PiP positions. Enter the value 9999 to use the default.
PU	PiP update – sets PiP size and position to values selected with W, H, X and Y commands
PR	PiP update, fixed aspect ratio – sets PiP size and position to values selected with PW, PX and PY commands, and caluclates a height to mnake the PiP window have 16:9 aspect ratio
PWxxxx	PiP width where xxxx is the number of horizontal pixels
PHyyyy	PiP height where yyyy is the number of vertical pixels
PXxxxx	PiP horizontal position where xxxx is the number of pixels from the left side of the screen.
PYyyyy	PiP vertical position where yyyy is the number of pixels from the top of the screen
AFMn	Set the PiP alpha mode. n = 0 - Constant Alpha (default) n = 1 - Visible color range. Colors within the specified range are made visible. Colors outside the range are transparent. n = 2 - Transparent color range. Colors within the specified range are made transparent. Colors outside the range are visible.

AFn	Set the PiP transparency where n is a single digit in the range 0 to 8. n = 0 - 0 % Transparent n = 1 - 12.5 % Transparent n = 2 - 25 % Transparent n = 3 - 37.5 % Transparent n = 4 - 50 % Transparent n = 5 - 67.5 % Transparent n = 6 - 75 % Transparent n = 7 - 87.5 % Transparent n = 8 - 100% Transparent
AFnnn	Set the PiP transparency where nnn is a three digit value in the range 000 (fully visible) to 255 (fully transparent).
AFXn	Set the transparency of the transparent colors of the PiP when using alpha mode 1 or 2. n is a single digit in the range 0 to 8. The default is 8. n = 0 - 0 % Transparent n = 1 - 12.5 % Transparent n = 2 - 25 % Transparent n = 3 - 37.5 % Transparent n = 4 - 50 % Transparent n = 5 - 67.5 % Transparent n = 6 - 75 % Transparent n = 7 - 87.5 % Transparent n = 8 - 100% Transparent
AFXnnn	Set the transparency of the transparent colors of the PiP when using alpha mode 1 or 2. Set the PiP transparency where nnn is a three digit value in the range 000 (fully visible) to 255 (fully transparent). The default is 255.
AFCRn,m	Set the Cr color selection range when using YCbCr selection mode. n is the lower end of the range and m is the upper end of the range. The color is specified in the range from 0 to 1023. The default is n=510 and m=514.
AFCBn,m	Set the Cb color selection range when using YCbCr selection mode. n is the lower end of the range and m is the upper end of the range. The color is specified in the range from 0 to 1023. The default is n=510 and m=514.
AFYn,m	Set the Luma color selection range when using YCbCr selection mode. n is the lower end of the range and m is the upper end of the range. The color is specified in the range from 0 to 1023. The default is n=0 and m=80.
AFRn	Set the Red color selection when using RGB selection mode. The color is specified as a value between 0 and 255. The default is 0.
AFGn	Set the Green color selection when using RGB selection mode. The color is specified as a value between 0 and 255. The default is 0.
AFBn	Set the Blue color selection when using RGB selection mode. The color is specified as a value between 0 and 255. The default is 0.
AFAn	Set a color tolerance value for RGB selection mode. The tolerance is specified in the range 0 to 255 where a higher number selects more colors. The default is 10.
AFVn	Set the visible edge mode. n is a value from 0 to 2.
AFTn	Set the transparent edge mode. n is a value from 0 to 2.

AFC0	Set the color range selection as YCbCr. The parameters set by AFCR, AFCB and AFY commands are used. This is the default.
AFC1	Set the color range selection as RGB. The parameters set by AFR, AFG, AFB, and AFA commands are used.
ZPF	Set PiP zoom function to be controlled in percentages by specifying center position and zoom factor. This is the default control mode. After setting this mode, use the ZPCX, ZPCY and ZPnnn commands to control the zoom function.
ZPW	Set PiP zoom to be controlled in pixels by specifying left edge and top edge position, and the width and height. After setting this mode, use the ZPLX, ZPLY, ZPLW, and ZPLH commands to setup the PiP window.
ZPCXnnn.d ZPCYnnn.d	Set the center of the PiP Zoom, where nnn.d is a number from 0 to 100 with up to 1 optional decimal place. This number represents a position in the PiP source to use as the zoom center point, specified in percent of the video width (ZPCX) or height (ZPCY). The resulting zoom window can never extend beyond the edge of the PiP video source. The DX-2200 automatically restricts the values to a valid range. The default setting is 50% for both horizontal and vertical, meaning the PiP is zoomed in toward its center. These commands only has an effect in center / zoom control mode. See the ZPF command.
ZPnnn.d	Set the zoom factor as a percentage from 100.0% to 800.0% with up to one optional decimal place. The default is 100% (no zoom). This command only has an effect in the center / zoom control mode. See the ZPF command.
ZPLXnnnn ZPLYnnnn ZPLWnnnn ZPLHnnnn	Set the PiP zoom window left edge (ZPLX), top edge (ZPLY), width (ZPLW) or height (ZPLH). Note: This command selects a region of the PiP input source to display, it does not set the position of the PiP window in the output video. For each command, nnnn represents the number of pixels. The DX-2200 automatically restricts the values to a valid range. The PiP zoom window cannot be less than 32x32 pixels, or extend beyond the edge of the PiP source. These commands only have an effect when specifying PiP window coordinates in pixels. See the ZPW command.
ZPR	Reset the PiP zoom / crop settings to the defaults
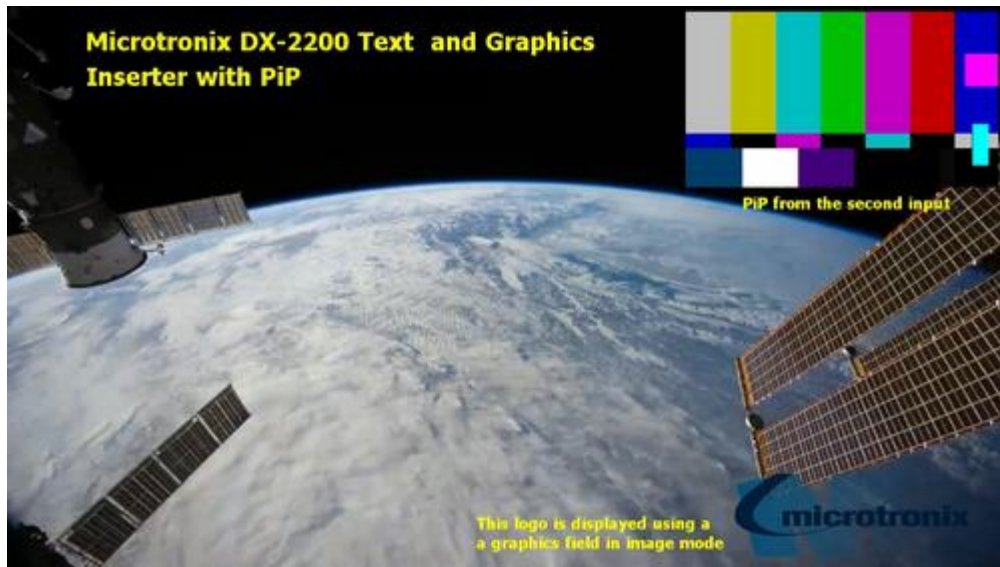
Figure 11: Sample of PiP, text and graphic logo OSD

4.8.1.9 Main Input Scaling and Position SERIAL Commands

These commands apply only to the Text Inserter With Scaling mode of operation (Mode 3, see the Mode Control Serial Commands).

The Text Inserter With Scaling Mode (Mode 3) provides the graphic overlay functions and two additional capabilities:

1) The option to zoom in on a selected region of the video source to allow cropping or display of a selected rectangular region of the source.

2) The video source can be mixed into the output as a reduced size window instead of filling the output video frame. This function is controlled by the Output Window Size and Position SERIAL Command Codes ("B" commands) shown in the table below

Table 8: Output Window Size and Position SERIAL Command Codes

Command Code	Mode of Operation
Mode Control Commands	
BXnnnn	Set the left edge location of the output video window in either pixels, or in percentage of the frame width by appending the '%' symbol. The window must always fit within the video frame. The DX-2200 will limit the value entered with this command to keep the window within the frame.
BYnnnn	Set the top edge location of the output video window window in either pixels, or in percentage of the frame height by appending the '%' symbol. The window must always fit within the video frame. The DX-2200 will limit the value entered with this command to keep the window within the frame.
BWnnnn	Set the width of the video output window in either pixels, or percentage of the video frame width by appending the '%' symbol. The value 9999 has a special meaning and causes the width to be calculated automatically from the height to maintain the aspect ratio. The DX-2200 will always limit the window size to prevent it being larger than the video frame.
BHnnnn	Set the height of the video output window in either pixels, or in percentage of the video frame height by appending the '%' symbol. The value 9999 has a special meaning and causes the height to be calculated automatically from the width to maintain the aspect ratio. The DX-2200 will always limit the window size to prevent it being larger than the video frame.
BR	Reset size and position to defaults
Where 'nnnn' can be a number of pixels between one and four digits in length, or be followed by a '%' sign to specify a percentage of the output frame size, eg '50%'. When specified in %, the value can be an integer between 0 to 100.	

Table 9: Text Inserter with Scaling Zoom SERIAL Command Codes

Command Code	Mode of Operation
Mode Control Commands	
ZSF	Set the zoom function to be controlled in percentages by specifying center position and zoom factor. This is the default control mode. After setting this mode, use the ZSCX, ZSCY and ZSnnn commands to control the zoom function.
ZSW	Set the zoom to be controlled in pixels by specifying left edge and top edge position, and the width and height. After setting this mode, use the ZSLX, ZSLY, ZSLW, and ZSLH commands to setup the PiP window.
ZSCXnnn.d ZSCYnnn.d	Set the center location of the Zoom, where nnn.d is a number from 0 to 100 with up to 1 optional decimal place. This number represents a position in the video source to use as the zoom center point, specified in percent of the video width (ZSCX) or height (ZSCY). The resulting zoom window can never extend beyond the edge of the video source. The DX-2200 automatically restricts the values to a valid range. The default setting is 50% for both horizontal and vertical, meaning the video is zoomed in toward its center. These commands only has an effect in center / zoom control mode. See the ZSF command.

ZSnnn.d	Set the zoom factor as a percentage from 100.0% to 800.0% with up to one optional decimal place. The default is 100% (no zoom). This command only has an effect in the center / zoom control mode. See the ZSF command.
ZSLXnnnn ZSLYnnnn ZSLWnnnn ZSLHnnnn	Set the zoom window left edge (ZSLX), top edge (ZSLY), width (ZSLW) or height (ZSLH). Note: This command selects a region of the input source to display, it does not set the position of the window in the output video. For each command, nnnn represents the number of pixels. The DX-2200 automatically restricts the values to a valid range. The zoom window cannot be less than 32x32 pixels, or extend beyond the edge of the source. These commands only have an effect when specifying the zoom window coordinates in pixels. See the ZSW command.
ZSR	Reset the zoom settings to the defaults

4.8.1.10 Graphic Overlay SERIAL Commands

The Graphic Overlay Serial Commands support three layers that can each display up to 48 user-defined Graphic Fields. Each Graphic Field can be configured to be Text, Rectangle, Corner Marker, or Target Marker. The fields can be configured and positioned using the Graphic Overlay Serial Commands below.

Each Layer of the Graphic Overlay utilizes two frame buffers located in memory. One is these frame buffers (the active buffer) generates a video output that is mixed on top of the input video, while the other buffer (the spare buffer) is prepared for use.

The video output of the layer is updated by rendering all Graphic Fields into the spare buffer using the parameters that have been set for each Field. The amount of time required to render the text to the spare buffer depends on the number of pixels that must be drawn. Typically, the rendering process takes more than one frame to complete. During this time, the active buffer continues to provide the Graphic Overlay video output. After rendering is complete, the DX-2200-TI switches the active and spare buffers. The buffer that was active before the update becomes the new spare buffer and is cleared by the unit to so that it is ready for text to be rendered again when the next update occurs. Buffer switching is always performed at the end of frame.

Many of the Graphic Field commands update the parameters of a Field (for example the visibility, color or transparency), but do not update the video output. This allows the user to change as many parameters as required before sending a command to show the updated output.

4.8.1.10.1 ACTIVE LAYER

The Graphics Overlay of the DX-2200-TI-03 has three layers named *Graphics Layer 1*, *Graphics Layer 2* and *Graphics Layer 3*. The Graphic Overlay Commands do not include the layer number in the command syntax. Instead, the commands always operate on the Active Layer. To select the Active Layer, the GLn command is used where n is the layer number from 1 to 3. The default Active Layer is Graphics Layer 2.

Additionally, *Graphics Layer 1* can also be accessed by the 'S' commands (See Graphic Layer 1 Overlay SERIAL Commands). These commands always refer to *Graphic Layer 1* regardless of the Active Layer.

4.8.1.10.2 GRAPHIC FIELDS

Graphic Fields are numbered 1 through 48. The Graphic Overlay Commands that apply to a single field include the field number in the command, for example, the GnnS command enables display of field number nn.

For any command that uses a field number, the field can be specified as either a 1 or 2 digit number in the range 1 through 48.

Instead of specifying a single field, the commands can be applied to all fields on the layer by specifying a field number of 0. For example G0S enables the display all fields on the layer and is equivalent to the commands G1S, G2S, G3S… G48S.

Commands can be applied to a range of sequential fields using the syntax "f1-f2" for the field number where f1 is the first field and f2 is the last field the command applies to. For example the command G7-10S enables display of fields 7, 8, 9, and 10.

By default, all Graphic Fields are turned off and have default parameters. To display a field, the following steps are required:

1) the field must be configured with the required field type
2) the parameters must be set appropriately
3) display of the field must be enabled
4) the layer must be updated

Some commands combine the last two operations in the above list, for example the G2S command enables the display of Graphic Field 2 (on the active layer) and also updates the layer.

4.8.1.10.2.1   Example: Drawing a Rectangle

The following commands are a simple example that displays a rectangle. These commands are intended for use with the DX-2200-TI in the factory default configuration:

G1M2	' Set Field 1 to be a Rectangle Field
G1PA100,100	' Coordinate A = (100,100)
G1PB300,300	' Coordinate B = (300,300)
G1S	' Enable display of Field 1 and update the layer

4.8.1.10.3 RESET GRAPHIC FIELD

A Graphic Field can be reset to its default values with the GnnZ command where nn is the Graphic Field number to reset. The GZ command will reset all Graphic Fields on the Active Layer, and the G0Z command resets the fields on all layers to default.

Resetting a Graphic Field will clear the Text string, set the line color to white with full visibility, set the position to the top left corner, set the fill color to blue but fully transparent (not visible), and set the font to the default for the current video resolution. The overall visibility of the Field is set to off.

Resetting fields does not automatically update the video output of the overlay. Any fields that are visible in the video are not cleared until a command is received that causes the overlay to be updated.

4.8.1.10.4 GRAPHIC FIELD VISIBILITY

Each Graphic Field can be turned on or off independently. By default, fields are off. The GnnV, GnnS, and GnnH commands control the visibility of field number nn. GnnS and GnnH turn visibility on and off respectively, and GnnV toggles visibility between on and off. Using any one of these commands will also cause the video output to be updated by rendering the fields to the spare buffer and performing a buffer swap. For this reason, it may be undesirable to use these commands when several text fields need to be turned on or off because the video output will be updated as each command is executed. This will result in the fields turning on or off one at a time.

The commands GnnVN, GnnSN, and GnnHN also control the visibility of Graphic Field nn, but without updating the output and are recommended when the visibility of more than one field is to be changed at the same time. The GU command can be sent to update the output after all visibility changes have been made.

The GnnHdddd command will turn off the visibility of text field nn after approximately dddd frames of video have been output. When the GnnH is used with a delay, the overlay is automatically updated after the delay.

4.8.1.10.5 UPDATE GRAPHIC OVERLAY

The GU command updates the video output of the Overlay by rendering all fields to the spare buffer and exchanging the active and spare buffers.

After sending a sequence of commands that change the parameters of fields, send the GU command to make the changes visible.

4.8.1.10.6 COORDINATE SYSTEM AND FIELD POSITION

Each Graphic Field has two position coordinates referred to as Coordinate A and Coordinate B. One or both of these coordinates may be used depending on the Graphic Field Type.

The coordinate system designates x=0000 and y=0000 as the top-left corner of the overlay for all video formats. This is the default position for all fields.

The maximum value for the x and y coordinates is located at the bottom-right corner of the frame. For 1080p, 1080i, and 1080PsF formats the bottom-right corner is at coordinates x=1919, y=1079. For 720p formats the bottom-right corner is located at x=1279, y=719. For NTSC format the coordinates are x=719, y=485, and for PAL format x=719 and y=575.

Note: Some monitors will not display the entire video frame, particularly when operating in NTSC or PAL modes. Graphic Fields placed close to the edges of the overlay may not be visible on some monitors.

Note: If the Overlay has been re-sized, the coordinate range may be smaller than the defaults for each video mode listed above.

Any Field or portion of a Field that extends beyond the edges of the Overlay will not be visible.

The Graphics Field command set provides different options for setting the coordinates of a Graphic Field. The commands GnnXxxxx, and GnnYyyyy set the x and y position for Coordinate A individually. The commands GnnPAXxxxx and GnnPAYyyyy perform the same functions, but this form of the command can also set Coordinate B, for example GnnPBXxxxx or GnnPBYyyyy.

If it also possible to set both x and y in a single command for Coordinate A or Coordinate B with the commands GnnPAxxxx,yyyy and GnnPBxxxx,yyyy respectively. For all Graphic Field position commands, the parameters xxxx and yyyy can be from 1 to 4 digits in length and may optionally be prefixed with zeros. For example, sending G4X0200 and G4Y0400 sets the field position to (200, 400).

Changing the text position does not automatically update the video output.

Figure 12: Sample of active text and graphic logo

4.8.1.10.7 LINE COLOR AND TRANSPARENCY

Each Graphic Field has a Line Color specified by Red, Green, and Blue Components in the range from 0 to 255. The Line Color is used for solid rectangles, for the outline of open rectangles, for corner markers, target markers, and the foreground of text.

The colors are entered as three Serial Commands by sending a Red, Green and Blue Serial Command. For example: sending G1R220, G1G025 and G1B250 sets Text Field 1 to purple.

The default color is white (R255, G255, and B255). Changing the text color does not automatically update the video output.

The Line Color has a transparency property that can be controlled using the G1Aaaa command to set the alpha value for mixing with underlying layers. Setting the alpha value to 0 sets the Line Color to be fully visible and no content on lower video layers will be visible through the Line Color. An alpha of 255 sets the Line Color fully transparent. At this setting the color will be completely invisible.

For example: sending G1A192 makes Field 1 approximately 75% transparent. Changing the text transparency does not automatically update the video output.

4.8.1.10.8 BACKGROUND COLOR AND TRANSPARENCY

Each Field has a Background Color that is used for the background of Text Fields and the fill color of rectangles. Background Color is set in the same way as Line Color, except the commands used as GnnBRrrr, GnnBGggg, GnnBBbbb, and GnnBAaaa.

The following example commands set the Background Color of Graphic Field 1 to yellow with partial (50%) visibility: G1BR255, G1BG255, G1BB0, and G1BA128.

The Background Color will only affect those field types that make use of the Background Color.
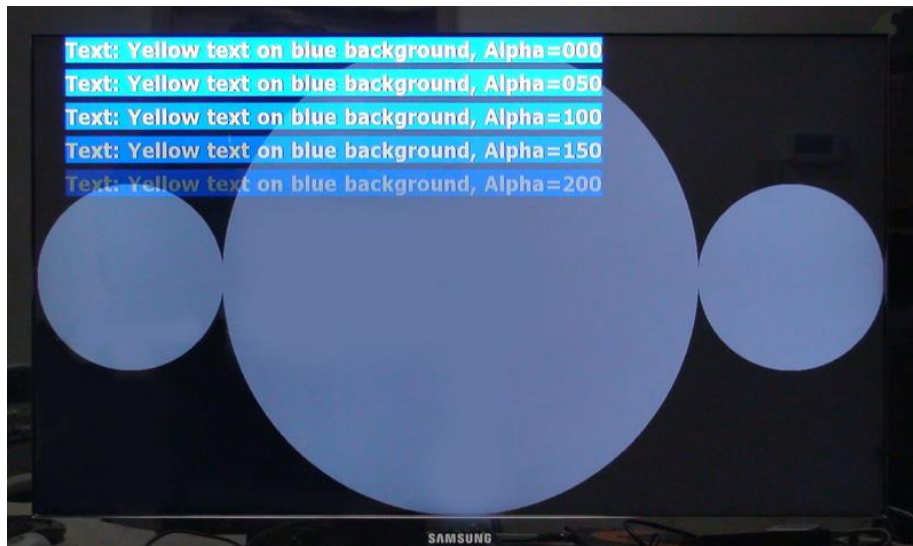
Figure 13: Sample of transparent text and background

Notes:

1) When the text is partially transparent, its apparent color will be determined by the text color, the background color and the visibilities of the text and background.

2) When a text background is displayed, the total number of color / transparency combinations is limited. Small changes in the color or transparency parameters of the text or background may not change the appearance

4.8.1.10.9 TEXT FONT

For each Graphic Field, a font / size combination can be selected using the GnnFfff command to select one of the font options in the Text and Symbol Font Table.

Table 10: Text and Symbol Fonts

Font Code	Font Name	Height Pixels	Fixed Width	Code Range (Hexadecimal)
12	Tahoma Bold	18		20-7E & A0-FF
1	Tahoma Bold	26		20-7E & A0-FF
13	Tahoma Bold	32		20-7E & A0-FF
2	Tahoma Bold	40		20-7E & A0-FF
25	Tahoma Bold	48		20-7E & A0-FF
14	Tahoma Bold	60		20-7E & A0-FF
3	Tahoma Bold	78		20-7E & A0-FF
15	Tahoma Bold	116		20-7E & A0-FF
4	Tahoma Bold	156		20-7E & A0-FF
16	Tahoma Regular	18		20-7E & A0-FF
17	Tahoma Regular	26		20-7E & A0-FF
18	Tahoma Regular	32		20-7E & A0-FF
19	Tahoma Regular	40		20-7E & A0-FF

24	Tahoma Bold	48		20-7E & A0-FF
20	Tahoma Regular	60		20-7E & A0-FF
21	Tahoma Regular	78		20-7E & A0-FF
22	Tahoma Regular	116		20-7E & A0-FF
23	Tahoma Regular	156		20-7E & A0-FF
26	Vera Sans Mono Regular	18	✓	20-7E & A0-FF
27	Vera Sans Mono Regular	26	✓	20-7E & A0-FF
28	Vera Sans Mono Regular	32	✓	20-7E & A0-FF
29	Vera Sans Mono Regular	40	✓	20-7E & A0-FF
30	Vera Sans Mono Regular	48	✓	20-7E & A0-FF
31	Vera Sans Mono Regular	60	✓	20-7E & A0-FF
32	Vera Sans Mono Regular	78	✓	20-7E & A0-FF
33	Vera Sans Mono Regular	116	✓	20-7E & A0-FF
34	Vera Sans Mono Regular	156	✓	20-7E & A0-FF
35	Vera Sans Mono Bold	18	✓	20-7E & A0-FF
36	Vera Sans Mono Bold	26	✓	20-7E & A0-FF
37	Vera Sans Mono Bold	32	✓	20-7E & A0-FF
38	Vera Sans Mono Bold	40	✓	20-7E & A0-FF
39	Vera Sans Mono Bold	48	✓	20-7E & A0-FF
40	Vera Sans Mono Bold	60	✓	20-7E & A0-FF
41	Vera Sans Mono Bold	78	✓	20-7E & A0-FF
42	Vera Sans Mono Bold	116	✓	20-7E & A0-FF
43	Vera Sans Mono Bold	156	✓	20-7E & A0-FF
44	Vera Sans Mono Bold	256	✓	20-7E & A0-FF
5	BGP Courier	26	✓	20-7E
6	BGP Courier	40	✓	20-7E
7	Larable Bold	26	✓	20-7E
8	Larable Bold	40	✓	20-7E
9	Wingdings	40		20-5F
10	Wingdings	80		20-5F
11	Wingdings	160		20-5F

Notes:

1) Refer to Table 29: Extended ASCII Character Table for a list of characters that are mapped to codes A0-FF.

2) Refer to Table 28: Windings Character Table for a list of characters and their codes.

Fonts are loaded into memory individually the first time a layer update is performed that requires them. The requirement to load the font makes the first layer update significantly slower.

Selecting font 0 uses a default font that varies depending on the video output resolution. For NTSC, PAL and 720p, the default font is Font 1, and for 1080i and 1080p the default is Font 2. If the font has been set, it can be restored to the default by selecting font 0. For example, the G2F0 command restores text field #2 to the default font.

Changing the text font does not automatically update the video output. The Text Font selection has no effect on Fields unless the field type is set to Text.
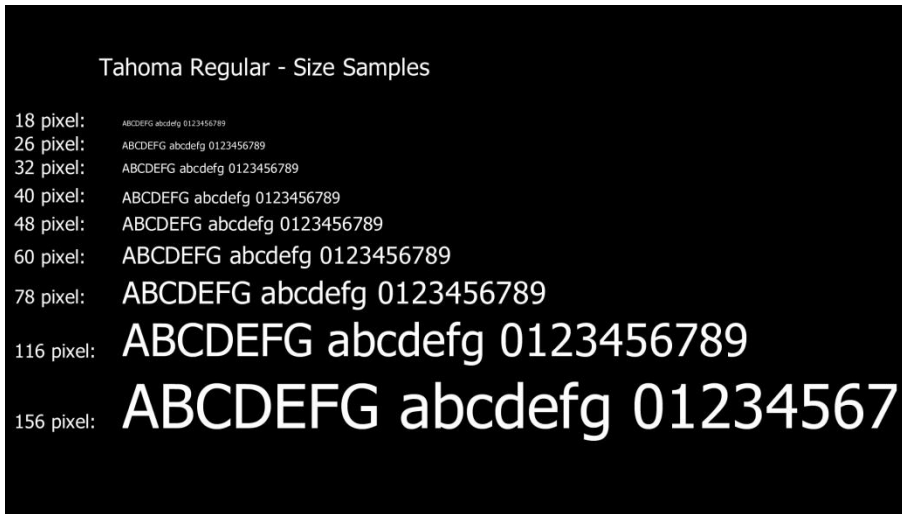
Figure 14: Sample of the available Tahoma font sizes
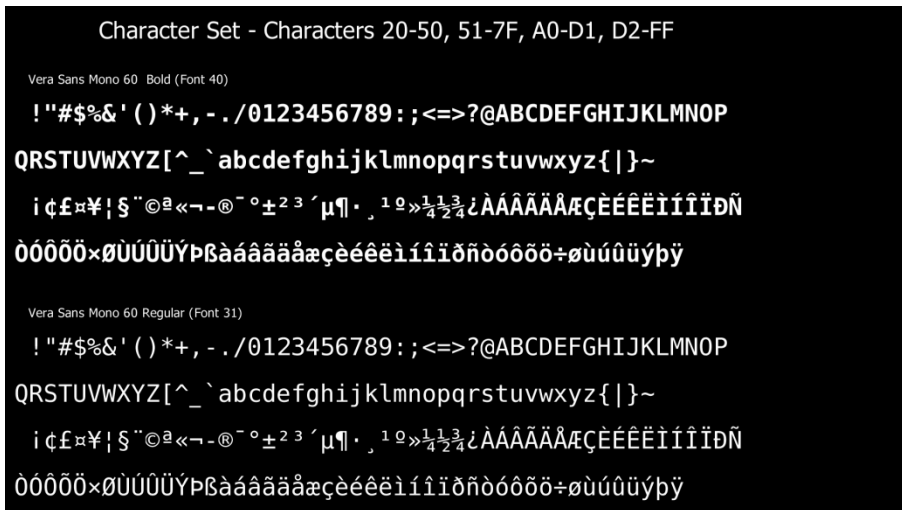
Figure 15: Character set - codes 20-7F and A0-FF

4.8.1.10.10 GRAPHIC FIELD TYPE

Each Graphic Field has a type that can be set by the GnnMm command. The following Field Types are supported:

- Field Type 1: Text (default)
- Field Type 2: Rectangle
- Field Type 3: Corner Markers
- Type 4: Target Marker
- Field Type 5: Image

The parameters for the Graphic Fields have different functions depending on the type of field being used. Each field type is described further below:

4.8.1.10.10.1 Text Fields – Field Type 1

Text Fields are used to display a string of ASCII characters. Up to 195 characters may be displayed in a field. For a list available fonts refer to Table 10: Text and Symbol Fonts.

The ASCII text is set using the GnnT"Text" command where the characters to be displayed are enclosed in the quotation marks. If a quotation mark is required in the test, it must be preceded by the backslash character. For example to set the text string for Field 7 to display Model "DX-2200-TI" use the command G07T"Model \"DX-2200-TI\"".

The color and transparency of the character can be configured using GnnRrrr, GnnGggg, GnnBbbb to set the red, green and blue component of the character color and GnnAaaa to set the transparency. Similarly, the background can be configured using GnnBRrrr, GnnBGggg, GnnBBbbb to set the color and GNBAaaa to set the transparency. The parameters rrr, ggg, bbb, and aaa must be in the range 0 to 255. For transparency, a value of 0 is fully visible and a value of 255 is fully transparent. The default text is white and fully visible. The default background is blue and fully transparent.

Coordinate A of the Graphic Field is used to specify the position for the top-left corner of the Text. Coordinate B is not used for Text Fields.

4.8.1.10.10.2 Text Field Display Example:

G4T" DX-2200-TI-03 "	' set the text to display
G4F3	' select Tahoma Bold 78 pixel height
G4R0	' character red=0
G4G255	' character green=255
G4B0	' character blue=0
G4A128	' 50% character visibility
G4BR0	' background red=0
G4BG0	' background green=0
G4BB64	' background blue=64
G4BA128	' 50% background transparency
G4X730	' start text at x=730
G4Y10	' start text at y=10
G4S	' enable Field 4 and update layer

4.8.1.10.10.3 Rectangle Fields – Field Type 2

Rectangle Fields are used to display a rectangle that can be either open or filled. A rectangle can be used as a vertical or horizontal line. The rectangle is drawn between Coordinate A and Coordinate B where Coordinate A must be the top-left corner and Coordinate B must be the bottom-right corner of the rectangle. No rectangle will be drawn if the coordinates are not specified in the correct order.

A rectangle may be drawn with either one or two regions depending on the parameters of the Graphic Field. The Line region is located around the perimeter of the rectangle and is drawn with the line color (as specified by the GnnRrrr, GnnGggg, GnnBbbb, and GnnAaaa commands). The Line region has a width in pixels that is specified in the width parameters of the Graphic Field. The default line width is 1pixel. If the line width is large, the entire interior of the rectangle may be part of the Line region. If the line width is narrow the interior of the rectangle contains a Fill region.

The command GnnWwwww set the line width to the same value for both the vertical and horizontal lines, and the command GnnWxxxx,yyyy sets the horizontal line widths (xxxx) and vertical widths (yyyy) independently. When the Width parameter is set to 0 in the above commands, or when the Width is greater than half the size of the rectangle, the entire rectangle is drawn with the line color. The line width can also be set for each side of the rectangle individually. The commands GnnWLwwww, GnnWRwwww, GnnWTwwww, and GnnWBwwww set the width of the left, right, top and bottom sides of the rectangle respectively. A

parameter value of zero has a different meaning for these commands than it does for the previous commands. When used with these four commands, the width value zero 0 prevents that side of the rectangle from being drawn.

The Fill color parameters are set by the GnnBRrrr, GnnBGggg, GnnBBbbb, and GnnBAaaa commands. By default, the Fill region is the entire interior of the rectangle that is not drawn in the Line color, but it is also possible to limit the fill to a specified width around the interior of the line. Each side of the rectangle has a fill width associated with it. The command GnnFXwwww sets the Fill width in pixels inside the left and right sides of the rectangle, and, GnnFYwwww sets the fill width inside the top and bottom sides of the rectangle.

The commands GnnFLwwww, GnnFRwwww, GnnFTwwww, and GnnFBwwww set the fill width for the left, right, top, and bottom sides individually. Any pixel that is within the fill width for one or more sides of the rectangle is part of the Fill region. The default fill width for the left side is 9999, causing the left side fill to extend throughout the entire interior of any rectangle. The default fill width for the right, top and bottom sides is 10 pixels.

When a fill region exists, it may either be drawn with the background color, or else the pixels can be left undrawn. The command GnnBD0 prevents the fill from being drawn, and the command GnnBD1 draws the fill. By default, the rectangle Fill is blue, fully transparent, and not drawn. Choosing not to draw the fill is different than drawing a fully transparent fill:

Transparent fill overwrites any pixels on the same layer drawn from a previously rendered field, but not drawing the fill leaves the previous pixels unchanged.

Drawing filled rectangles is slower than drawing unfilled rectangles.

4.8.1.10.10.4 Rectangle Field Display Example:

```
G2PA100,100              ' top-left corner at (100,100)
G2PB1820,980             ' bottom-Right corner at (1820,980)
G2M2                     ' type = Rectangle Field
G2W7,4                   ' line color 7 pixel wide along top/bottom
                         ' and 4 pixels wide at the sides
G2R0;G2G0;G2B255         ' line color = blue
G2A64                    ' line color is 25% transparent
G2BD1                    ' draw the fill region
G2BR0;G2BG0;G2BB255      ' fill is blue
G2BA224                  ' fill is 7/8 transparent
G2S                      ' enable display of field 2 and update
```

4.8.1.10.10.5 Corner Marker Fields – Field Type 3

Corner Marker Fields are used to indicate a region of interest in the video.

The Corner Markers are drawn outside the region specified by Coordinate A (top-left) and Coordinate B (bottom-right).

The Width parameter of the Graphic Field sets the width in pixels of the lines that make up the corner markers, and the Length parameter of the Graphic Field sets the distance in pixels that the lines extend from the corner.

Corner Markers are drawn in the line color (as specified by the GnnRrrr, GnnGggg, GnnBbbb, and GnnAaaa commands).

By default four corner markers are drawn. It is possible to suppress the corner markers individually using the GnnKcs command. The letter s represents either 1 to suppress the corner marker, or 0 to enable it. The letter c represents a letter that indicates which corner marker is being referenced as follows:

A = top-left

B = bottom-left

C = top-right

D = bottom-right

For example the command G1KB1 will suppress display of the bottom-left corner marker of Graphic Field 1.

NOTE: If the width of a Corner Marker is made too large relative to its length, the Corner Marker will appear as a square.

4.8.1.10.10.5.1　　　Corner Marker Field Display Example:

G1M3	' corner marker field type
G1PA100,100	' top-left at (100,100)
G1PB1820,980	' bottom-right at (1820,980)
G1W10	' 10 pixels wide
G1L300,150	' 300 px long horizontal, 150 px vertical
G1R255;G1G255;G1B0	' Yellow
G1A64	' 25% transparent
G1S	' display and update

4.8.1.10.10.6　Target Marker Fields – Field Type 4

The Target Marker Field displays a '+' marker at the position specified by coordinate A of the Graphic Field.

The Length parameter of the Graphic Field sets the length of the horizontal and vertical lines. Half the length extends each direction from the center of the Target Marker and the length has a resolution of 2 pixels so that the marker is always symmetrical.

The width parameter of the Graphic Field set the width of the lines that make up the Target Marker. The width has a resolution of 2 pixels with half the width on each side of center.

4.8.1.10.10.6.1　　　Target Marker Field Display Example:

G3M4	' target marker field type
G3PA960,540	' location (960,540)
G3W2	' 2 pixels wide
G3L100	' 100 pixel long lines
G3R255;G3G0;G3B0	' red
G3A0	' fully visible
G3S	' display and update

4.8.1.10.10.7　Image Fields – Field Type 5

An Image Field displays an image that has been uploaded to the DX-2200-TI-03. Image Fields can be used to display a logo or other custom graphics. The DX-2200 Uploader software supplied with the product is used to upload images and store them in flash memory. Refer to **§5**DX2200 Software Upload Utility DX-2200 Software Upload Utility for information about uploading images.

The image is displayed at the position specified by coordinate A of the Graphic Field. Any part of the image extending beyond the size of the overlay is not displayed.

Uploaded images may have transparency for some or all pixels in the image. Support for transparency depends on the file format of the image. Images that do not include transparency are always uploaded with all pixels fully visible. By default, images will be displayed with the transparency that was included in the

uploaded image. The GnnAaaa command can be used to make the image more transparent. It is not possible to make an image less transparent than was defined in the original file.

When an image is fully transparent or partly transparent, the image frame background will be visible behind the image. The background color is set by the GnnBRrrr, GnnBggg, GnnBBbbb commands, and the background transparency is set by the GnnBAaaa command. When the image frame background has transparency, lower layers in the video mix will be visible behind the image. The default background transparency for a graphic field is 255 (fully transparent). The image frame background will not be visible unless the default transparency is changed.

Images are specified by an ID number that is set when the image is uploaded to the product. If the requested image is not found in memory, then the Graphic Field has no effect.

Images are loaded from flash into main memory the first time they are required for a layer update. The first layer update using an image will be significantly slower than subsequent updates.

4.8.1.10.10.7.1 Image Field Display Example:

G5M5	' field type = Image field
G5PA800,300	' location (800,300)
G5I35	' display the image with id=35
G5A0	' display with the uploaded transparency
G5S	' display the field and update the overlay

4.8.1.10.10.8 Rectangle XYWH – Field Type 6

This rectangle field type is the same as field type 2 with the exception that it is specified by top/left corner and width/height instead of top/left corner and bottom/right corner. In some applications it may be more convenient or efficient to specify the rectangle with width and height.

The GnnPBxxxx,yyyy is used to specify the width and height of the rectangle. All other commands are the same as for field type 2 rectangles.

4.8.1.10.10.8.1 Rectangle Field Display Example:

G6PA800,300	' top left corner at 800, 300
G6PB200,400	' width 200 pixels, height 400 pixels
G6M6	' type = Rectangle Field XYWH
G6S	' enable display of field 6 and update

Figure 16: Sample of Rectangle, Target Marker and Text

Figure 17: Sample of Corner Markers, Target and Text

Table 11: Graphic Overlay SERIAL Commands

Command Code	Mode of Operation
	Graphic Overlay Commands
GLn	Select the active graphics layer. Subsequent graphics commands refer to the active layer. n = 1 Select Graphics Layer 1 n = 2 Select Graphics Layer 2 n = 3 Select Graphics Layer 3

Command Code	Mode of Operation
G0Z	Reset all Graphic Fields to default. This command affects the Fields on Graphic Layers 1, 2 and 3. The command resets the parameters of the Fields, but does not update any layers. The video output will not change for any layer until the next update of that.
GZ	Reset all Graphic Fields on the active layer to default. This command only resets the parameters of the Fields, but does not update the layer. The video will not change until the layer is updated.
GnnZ	Reset Graphic Field nn of the active layer to defaults. The layer is not automatically updated and the video will not change until the next update.
GnnMm	Select the type for Graphic Field nn. m = 1 Text m = 2 Rectangle m = 3 Corner Markers m = 4 Target Marker m = 5 Graphic Image m = 6 Rectangle specified by top/left corner and width/height
GU	Update the active layer. The Graphic Fields on the active layer are rendered to the spare frame buffer and when rendering is complete, the frame buffers are switched so that the spare buffer becomes active and the updated video is displayed. The new spare buffer is automatically cleared.
GnnV	For the active graphics layer, toggle the visibility of Graphic Field nn and update the layer.
GnnVN	For the active graphics layer, toggle the visibility setting for Graphic Field nn without updating the output. The visibility of the Field does not change until another command causes an update of the layer.
GnnS	For the active graphics layer, show (turn on) Graphic Field nn and update the layer so that the change becomes visible.
GnnSN	For the active graphics layer, enable the visibility setting for Graphic Field nn without updating the output. The Field does not appear until another command causes an update of the layer
GnnH	For the active graphics layer, hide (turn off) Graphic Field nn and update the layer to make the change visible.
GnnHN	For the active graphics layer, disable the visibility setting for a Graphic Field without updating the output. The Field remains visible until another command causes an update of the output.
GnnHffff	For the active graphics layer, Hide (turn off) Field nn after a delay of approximately ffff frames of video. ffff is a number between 1 and 4 digits in length. The layers is automatically updated when the delay expires.
GnnBRrrr	For Graphic Field nn on the active graphics layer, set the value of the red component of the background color to rrr, where rrr is a number between 1 and 3 digits in length and in the range 0 to 255. The background color is used for text background and for the fill region of a rectangle.
GnnBGggg	For Graphic Field nn on the active graphics layer, set the value of the green component of the background color to ggg, where ggg is a number between 1 and 3 digits in length and in the range 0 to 255. The background color is used for text background and for the fill region of a rectangle.

Command Code	Mode of Operation
GnnBBbbb	For Graphic Field nn on the active graphics layer, set the value of the blue component of the background color to bbb, where bbb is a number between 1 and 3 digits in length and in the range 0 to 255. The background color is used for text background and for the fill region of a rectangle.
GnnBAaaa	For Graphic Field nn on the active graphics layer, set the value of the transparency for the background to aaa, where aaa is a number between 1 and 3 digits in length and in the range 0 to 255. aaa = 0 makes the background fully visible. aaa = 255 makes the background fully transparent (invisible).
GnnBDm	For Graphic Field nn on the active layer, this command controls if the fill region of a rectangle is drawn, or if the pixels are left unchanged when the field is set to Rectangle mode. m = 0 - Do not draw the rectangle fill region m = 1 - Draw the rectangle fill region. Choosing to draw the fill region takes additional time to render and will overwrite any pixels on the same layer, even if the fill is transparent.
GnnRrrr	For Graphic Field nn on the active graphics layer, set the value of the red component of the line color to rrr, where rrr is a number between 1 and 3 digits in length and in the range 0 to 255. The line color is used for text characters, the line region of rectangles, and for corner markers and the target marker.
GnnGrrr	For Graphic Field nn on the active graphics layer, set the value of the green component of the line color to ggg, where ggg is a number between 1 and 3 digits in length and in the range 0 to 255. The line color is used for text characters, the line region of rectangles, and for corner markers and the target marker.
GnnBbbb	For Graphic Field nn on the active graphics layer, set the value of the blue component of the line color to bbb, where bbb is a number between 1 and 3 digits in length and in the range 0 to 255. The line color is used for text characters, the line region of rectangles, and for corner markers and the target marker.
GnnArrr	For Graphic Field nn on the active graphics layer, set the value of the transparency for the line or image to aaa, where aaa is a number between 1 and 3 digits in length and in the range 0 to 255. aaa = 0 makes the background fully visible. aaa = 255 makes the background fully transparent (invisible). The line color is used for text characters, the line region of rectangles, and for corner markers and the target marker.
GnnFXwwww	For Graphic Field nn on the active graphics layer, set the fill width (in pixels) associated with the top and bottom (horizontal) lines of a rectangle. wwww is a number between 1 and 4 digits in length. A width of zero means there is no fill associated with the top and bottom lines.
GnnFYwwww	For Graphic Field nn on the active graphics layer, set the fill width (in pixels) associated with the left and right (vertical) lines of a rectangle. wwww is a number between 1 and 4 digits in length. A width of zero means there is no fill associated with the left and right lines.

Command Code	Mode of Operation
GnnFLwwww	For Graphic Field nn on the active graphics layer, set the fill width (in pixels) associated with the left line of a rectangle. wwww is a number between 1 and 4 digits in length. A width of zero means there is no fill associated with the left line.
GnnFRwwww	For Graphic Field nn on the active graphics layer, set the fill width (in pixels) associated with the right line of a rectangle. wwww is a number between 1 and 4 digits in length. A width of zero means there is no fill associated with the right line.
GnnFTwwww	For Graphic Field nn on the active graphics layer, set the fill width (in pixels) associated with the top line of a rectangle. wwww is a number between 1 and 4 digits in length. A width of zero means there is no fill associated with the top line.
GnnFBwwww	For Graphic Field nn on the active graphics layer, set the fill width (in pixels) associated with the bottom line of a rectangle. wwww is a number between 1 and 4 digits in length. A width of zero means there is no fill associated with the bottom line.
GnnWxxxx,yyyy	For the active graphics layer, set the Width parameter of Graphic Field nn to the value xxxx for the horizontal direction and to the value yyyy for the vertical-direction. xxxx and yyyy are numbers between 1 and 4 digits in length. For Rectangles, Width is the number of pixels drawn in the line color at the perimeter of the rectangle. Any remaining pixels inside the rectangle are the fill region and are drawn with the fill color (if drawing of the fill is enabled). If width is zero, the entire rectangle is drawn in the line color. For Corner markers, Width is the width in pixels of the lines that make up the corner markers. For the Target Marker, Width is the width in pixels of the vertical and horizontal lines that form the Target Marker. Width has a resolution of two pixels so that the target marker is always symmetrical with ½ the width drawn on each side of the center.
GnnWwwww	For the active graphics layer, sets the Width parameter of Graphic Field nn to the value wwww for both horizontal and vertical directions. wwww is a number between 1 and 4 digits in length.
GnnWLwwww	For field nn on the active graphics layer, set the Line width of the left side of a rectangle to the value wwww. wwww is a number between 1 and 4 digits in length. A width of zero causes the left line to be suppressed. Note: This command has no effect for corner marker or target fields
GnnWRwwww	For field nn on the active graphics, set the Line width of the right side of a rectangle to the value wwww. wwww is a number between 1 and 4 digits in length. A width of zero causes the right line to be suppressed. Note: This command has no effect for corner marker or target fields
GnnWTwwww	For field nn on the active graphics layer, set the Line width of the top side of a rectangle to the value wwww. wwww is a number between 1 and 4 digits in length. A width of zero causes the top line to be suppressed. Note: This command has no effect for corner marker or target fields

Command Code	Mode of Operation
GnnWBwwww	For field nn on the active graphics layer, set the Line width of the bottom side of a rectangle to the value wwww. wwww is a number between 1 and 4 digits in length. A width of zero causes the bottom line to be suppressed. Note: This command has no effect for corner marker or target fields
GnnLxxxx,yyyy	Set the Length parameter of Graphic Field nn to the value xxxx for the x direction and to the value yyyy for the y-direction. xxxx and yyyy are numbers between 1 and 4 digits in length. For Corner Markers, Length is the distance in pixels each marker extends from its corner. For the Target Marker, length is the length in pixels of the horizontal and vertical lines and has a resolution of 2 pixels so that the Target Marker is always symmetrical with ½ the length on each side of the center point.
GnnLaaaa	Sets the Length parameter of Graphic Field nn to the value aaaa for both x and y directions. aaaa is a number between 1 and 4 digits in length.
GnnKcs	For the active graphics layer, set the control parameters for Graphic Field nn. c = Parameter identifier, referenced by letter, from A to H inclusive s = 1 to enable the function, or 0 to disable For Corner Marker Fields, parameter A = suppress top-left marker parameter B = suppress bottom-left marker parameter C = suppress top-right marker parameter D = suppress bottom-right marker
GnnT"ASCII text"	For the active graphics layer, set the ASCII text string for Graphic Field nn. The text string is used when the Field type is set to Text. "ASCII text" is the content of the string framed with quotation marks.
GnnImmmm	For the active graphics layer, set the image number for Graphic Field nn to the value mmmm. mmmm is a number between 0 and 9999 that determines what image is displayed when the graphic field type is set to Image.
GnnFfff	For the active graphics layer, set the font & size for Field nn. fff is a number of between 1 and 3 digits in length. Refer to Table 10: Text and Symbol Fonts for the list of choices. The default for 720p and 1080p is font 1 and 2 respectively.
GnnPAxxxx,yyyy GnnPBxxxx,yyyy	For the active graphics layer, set location coordinates for Graphic Field nn. Each Field has two location coordinates referenced by letter, either 'A' or 'B'. Coordinate A is the top-left position of a Rectangle Field, Text Field, or Corner Marker Field, and is the center position of a Target Marker Field. Coordinate B is the bottom-right position of a Rectangle Field or Corner Marker Field. xxxx and yyyy are numbers between 1 a 4 digits in length.
GnnXxxxx	For the active graphics layer, set the x-direction position for coordinate A of the Graphic Field nn. This command is included for compatibility with the Text Overlay command set.
GnnXaaaa,bbbb	For Graphic Field nn on the active graphics layer, set the x-direction position for coordinate A to the value aaaa and set the x-direction coordinate B to the value bbbb.

Command Code	Mode of Operation
GnnYyyyy	For the active graphics layer, set the y-direction position for coordinate A of the Graphic Field nn. This command is included for compatibility with the Text Overlay command set.
GnnYaaaa,bbbb	For Graphic Field nn on the active graphics layer, set the y-direction position for coordinate A to the value aaaa and set the y-direction coordinate B to the value bbbb.
GnnPAXxxxx GnnPBXxxxx	For Graphic Field nn on the active graphics layer, set only the x-direction location of either coordinate A or coordinate B.
GnnPAYyyyy GnnPBYyyyy	For Graphic Field nn on the active graphics layer, set only the y-direction location of either coordinate A or coordinate B.
GnnNm	For Graphic Field nn, set the justification mode. These commands use the field length that is set separately by the SnnJmm command. m = 0 No justification is selected m = 1 Display the text string left justified in the field. If the string is longer than the field, it is clipped at the right. If the string is shorter than the field it is padded with spaces at the right. m = 2 Display the text string right justified in the field. If the string is longer than the field, it is clipped at the left. If the string is shorter than the field, the string is padded with spaces at the left. m = 3 Display the text string right justified in the field. If the string is longer than the field, the field expands to fit the string. If the string is shorter than the field, the string is padded with spaces at the right. m = 4 Display the text string centered in the field. If the string is longer than the field, it is clipped at the left. If the string is shorter than the field, it is padded with spaces before and after to center it.
GnnJmm	For Graphic Field nn, set the field length to mm characters for justification. If the field length is 0, justification is disabled.

4.8.1.10.11   LOW LEVEL GRAPHIC COMMANDS

The Low Level Graphic Commands provide an additional level of control over switching between the active and spare overlay buffers and in rendering Graphic Fields. In certain situations the use of these commands can provide fast update rates for the Overlay.

The Graphics Overlays of the DX-2200-TI-03 use two memory frame buffers. One of these buffers is the active buffer that provides a video output that is mixed on top of the input video and the other is the spare buffer where the next image is rendered when the text overlay is updated. In normal operation of the text overlay, updating the output video requires rendering all Text Fields to the spare buffer, then exchanging the two buffers and clearing the new spare buffer to prepare for the next update.

The Low Level Commands provide additional control of the process for cases where:

1) The time when the text overlay update becomes visible must be controlled more accurately than is possible with the standard text overlay commands.

Faster updates are required, especially in cases when 2 or more text fields displayed but not all fields need to be changed.

Table 12: Low Level Graphic Overlay Commands

Command Code	Mode of Operation
Low Level Graphic Overlay Commands	
GB	Renders the graphic fields of the active layer to the spare buffer, but the buffers are not swapped. The video output does not change.
GW	Swap the active and spare buffers on the active graphics layer, and then clear the new spare buffer. No fields are rendered and the spare buffer is displayed with its existing content.
GS	Swap the active and spare buffers on the active graphics layer without rendering and fields or clearing of any buffers
GC	For the active graphics layer, clear the spare buffer
GnU GnnU	For the active graphics layer, render only the field number specified to the spare buffer.

NOTE: When a configuration is saved to Flash, the current parameters of the Graphic Fields are saved and will be rendered to the active buffer when the DX-2200-TI power up. If the Low Level Graphic Overlay Commands have been used, the overlay may be in a state that is dependent on both the Graphic Field settings and sequence of past commands. In that case the overlay will not appear the same when the fields are rendered again at power up.

4.8.1.10.11.1 Application Example 1

Suppose that it's necessary to update the Graphic Overlay at a specific time. If the G1T command has been used to configure a Field to display text, then executing GU will not take immediate effect because the Fields must be rendered to the spare buffer before the buffer is switched. The time required to render the Field depends on the number of characters drawn and the font size. This causes a noticeable delay from the time the command is sent to when the video is updated.

By using the Low Level Graphic Overlay Commands the overlay update can be controlled more accurately. After setting the Text Field with the G1T command, execute GB to render the text to the spare buffer. This must be done prior to the desired switching time so that there is time to render to the spare buffer. The spare buffer now contains the updated output, but it not yet being displayed. When the update is to be displayed, execute the GW command and the buffers will be switched at the end of the current frame to make the update visible.

4.8.1.10.11.2 Application Example 2

Suppose that 5 text fields are being displayed on a layer and that one field needs to be updated regularly (in the same screen location) while the others do not change. In this case it's possible to use the Low Level Graphic Overlay Commands to update only the one field that changes to avoid re-rendering the other four fields that don't need to change. This also avoids the time required to clear the spare buffer.

Configure all 5 fields as required and enable display of the fields, then update the overlay so they are visible. Execute the GB command to render all the fields to the spare buffer. The GB command does not switch buffers or clear the spare buffer. At this point, both overlay buffers will contain identical images. When the SS command is executed the overlay can switch between the two buffers. Next, the content of one field can be changed with the GnnT command, and GnnU can be used to render only that string to the spare buffer. When SS is executed, the buffers will be switched and the update is displayed without need of rendering the other strings that were not changed.

Note that this procedure never clears the spare buffer and so no pixels can be removed from the overlay except by overwriting them with different text or blank spaces. If the length of the new string is shorter than the previous string, spaces can be appended to overwrite the pixels of the previous string. When leaving this mode of operation, the GC command should be executed to clear the spare buffer so that it's in the state expected by the other overlay commands.

4.8.1.11 Graphic Layer 1 Overlay SERIAL Commands

The Graphic Layer 1 Overlay Serial Commands are almost identical to the Graphic Overlay Serial Commands except that they automatically refer to the fields on *Graphics Layer 1*. These commands provide a convenient method of accessing the top layer without specifying the Active Layer, and also provide compatibility with previous versions of the DX-2200 products. Each command begins with the letter 'S' instead of the letter 'G'.

For example, the commands: GL1; G3T" DX-2200" select *Graphics Layer 1* and set the text string for Graphic Field 3. The command S3T" DX-2200" performs the same function without changing the Active Layer.

Refer to Table 13: Graphic Layer 1 Overlay SERIAL Commands and Table 14: Graphic Layer 1 Low Level Overlay Commands for more details.

4.8.1.11.1 EXAMPLES OF GRAPHIC LAYER 1 OVERLAY COMMANDS

4.8.1.11.1.1 Example 1: Graphic Layer 1 Overlay Commands

Display of a single text field with the following attributes:

- Text: A sample of RED text on a WHITE background
- Text size: 2
- Position: X=100, Y= 200
- Color: red
- Background Color: white
- Background Visibility: 100%

The SERIAL Commands to display this text as Field 1 are as follows:

```
S1T"A sample of RED text on a WHITE background"
S1F2
S1X100
S1Y200
S1R255
S1G0
S1B0
S1BA0
S1BR255
S1BG255
S1BB255
S1S
```

Figure 18: Example 1 – red text OSD with white background

This text field can be updated and replaced with new text have the same attributes by overwriting with a new text string. For example, if the new text was:

This is an updated text string for Text Field 1

The command would be:

    S1T"This is an updated text string for Text Field 1"
    SU

4.8.1.11.1.2   *Example 2: Graphic Layer 1 Overlay Commands*

The addition of a second text field with the default font and color:

- Text: A text sample using default values for Text Field 2
- Default text size at 720p: 002
- Position: X=0600, Y=0200
- Default color: white

The SERIAL Commands to display this text as Field 2 are as follows:

    S2T"A text sample using default size for Text Field 2"
    S2X0600
    S2Y0200
    S2S

The command to turn Text Field 1 off is:

    S1H

Figure 19: Example 2 – sample of default text

Table 13: Graphic Layer 1 Overlay SERIAL Commands

Command Code	Mode of Operation
	Graphic Layer 1 Overlay Commands
SZ	Reset all Graphic Fields on Layer 1 to default. This command only resets the parameters of the Fields, but does not update the layer. The video will not change until the layer is updated.
SnnZ	Reset Graphic Field nn of Layer 1 to defaults. The layer is not automatically updated and the video will not change until the next update.
SnnMm	Select the type for Graphic Field nn. m = 1 Text (default) m = 2 Rectangle m = 3 Corner Markers m = 4 Target Marker m = 5 Graphic Image m = 6 Rectangle specified by top/left corner and width/height
SU	Update Layer 1. The Graphic Fields on the active layer are rendered to the spare frame buffer and when rendering is complete, the frame buffers are switched so that the spare buffer becomes active and the updated video is displayed. The new spare buffer is automatically cleared.
SnnV	For Layer 1, toggle the visibility of Graphic Field nn and update the layer.
SnnVN	For Layer 1, toggle the visibility setting for Graphic Field nn without updating the output. The visibility of the Field does not change until another command causes an update of the layer.
SnnS	For Layer 1, show (turn on) Graphic Field nn and update the layer so that the change becomes visible.

Command Code	Mode of Operation
SnnSN	For Layer 1, enable the visibility setting for Graphic Field nn without updating the output. The Field does not appear until another command causes an update of the layer
SnnH	For Layer 1, hide (turn off) Graphic Field nn and update the layer to make the change visible.
SnnHN	For Layer 1, disable the visibility setting for a Graphic Field without updating the output. The Field remains visible until another command causes an update of the output.
SnnHffff	For Layer 1, Hide (turn off) Field nn after a delay of approximately ffff frames of video. ffff is a number between 1 and 4 digits in length. The layers is automatically updated when the delay expires.
SnnBRrrr	For Graphic Field nn on Layer 1, set the value of the red component of the background color to rrr, where rrr is a number between 1 and 3 digits in length and in the range 0 to 255. The background color is used for text background and for the fill region of a rectangle.
SnnBGggg	For Graphic Field nn on Layer 1, set the value of the green component of the background color to ggg, where ggg is a number between 1 and 3 digits in length and in the range 0 to 255. The background color is used for text background and for the fill region of a rectangle.
SnnBBbbb	For Graphic Field nn on Layer 1, set the value of the blue component of the background color to bbb, where bbb is a number between 1 and 3 digits in length and in the range 0 to 255. The background color is used for text background and for the fill region of a rectangle.
SnnBAaaa	For Graphic Field nn on Layer 1, set the value of the transparency for the background to aaa, where aaa is a number between 1 and 3 digits in length and in the range 0 to 255. aaa = 0 makes the background fully visible. aaa = 255 makes the background fully transparent (invisible).
SnnBDm	For Graphic Field nn on Layer 1, this command controls if the fill region of a rectangle is drawn, or if the pixels are left unchanged when the field is set to Rectangle mode. m = 0 - Do not draw the rectangle fill region m = 1 - Draw the rectangle fill region. Choosing to draw the fill region takes additional time to render and will overwrite any pixels on the same layer, even if the fill is transparent.
SnnRrrr	For Graphic Field nn on Layer 1, set the value of the red component of the line color to rrr, where rrr is a number between 1 and 3 digits in length and in the range 0 to 255. The line color is used for text characters, the line region of rectangles, and for corner markers and the target marker.
SnnGrrr	For Graphic Field nn on Layer 1, set the value of the green component of the line color to ggg, where ggg is a number between 1 and 3 digits in length and in the range 0 to 255. The line color is used for text characters, the line region of rectangles, and for corner markers and the target marker.
SnnBbbb	For Graphic Field nn on Layer 1, set the value of the blue component of the line color to bbb, where bbb is a number between 1 and 3 digits in length and in the range 0 to 255. The line color is used for text characters, the line region of rectangles, and for corner markers and the target marker.

Command Code	Mode of Operation
SnnArrr	For Graphic Field nn on Layer 1, set the value of the transparency for the line or image to aaa, where aaa is a number between 1 and 3 digits in length and in the range 0 to 255. aaa = 0 makes the background fully visible. aaa = 255 makes the background fully transparent (invisible). The line color is used for text characters, the line region of rectangles, and for corner markers and the target marker.
SnnFXwwww	For Graphic Field nn on Layer 1, set the fill width (in pixels) associated with the top and bottom (horizontal) lines of a rectangle. wwww is a number between 1 and 4 digits in length. A width of zero means there is no fill associated with the top and bottom lines.
SnnFYwwww	For Graphic Field nn on Layer 1, set the fill width (in pixels) associated with the left and right (vertical) lines of a rectangle. wwww is a number between 1 and 4 digits in length. A width of zero means there is no fill associated with the left and right lines.
SnnFLwwww	For Graphic Field nn on Layer 1, set the fill width (in pixels) associated with the left line of a rectangle. wwww is a number between 1 and 4 digits in length. A width of zero means there is no fill associated with the left line.
SnnFRwwww	For Graphic Field nn on Layer 1, set the fill width (in pixels) associated with the right line of a rectangle. wwww is a number between 1 and 4 digits in length. A width of zero means there is no fill associated with the right line.
SnnFTwwww	For Graphic Field nn on Layer 1, set the fill width (in pixels) associated with the top line of a rectangle. wwww is a number between 1 and 4 digits in length. A width of zero means there is no fill associated with the top line.
SnnFBwwww	For Graphic Field nn on Layer 1, set the fill width (in pixels) associated with the bottom line of a rectangle. wwww is a number between 1 and 4 digits in length. A width of zero means there is no fill associated with the bottom line.
SnnWxxxx,yyyy	For Layer 1, set the Width parameter of Graphic Field nn to the value xxxx for the x direction and to the value yyyy for the y-direction. xxxx and yyyy are numbers between 1 and 4 digits in length. For Rectangles, Width is the number of pixels drawn in the line color at the perimeter of the rectangle. Any remaining pixels inside the rectangle are the fill region and are drawn with the fill color (if drawing of the fill is enabled). If width is zero, the entire rectangle is drawn in the line color. For Corner markers, Width is the width in pixels of the lines that make up the corner markers. For the Target Marker, Width is the width in pixels of the vertical and horizontal lines that form the Target Marker. Width has a resolution of two pixels so that the target marker is always symmetrical with ½ the width drawn on each side of the center.
SnnWwwww	For Layer 1, set the Width parameter of Graphic Field nn to the value wwww for both x and y directions. wwww is a number between 1 and 4 digits in length.

Command Code	Mode of Operation
SnnWLwwww	For field nn on Layer 1, set the Line width of the left side of a rectangle to the value wwww. wwww is a number between 1 and 4 digits in length. A width of zero causes the left line to be suppressed. Note: This command has no effect for corner marker or target fields
SnnWRwwww	For field nn on Layer 1, set the Line width of the right side of a rectangle to the value wwww. wwww is a number between 1 and 4 digits in length. A width of zero causes the right line to be suppressed. Note: This command has no effect for corner marker or target fields
SnnWTwwww	For field nn on Layer 1, set the Line width of the top side of a rectangle to the value wwww. wwww is a number between 1 and 4 digits in length. A width of zero causes the top line to be suppressed. Note: This command has no effect for corner marker or target fields
SnnWBwwww	For field nn on Layer 1, set the Line width of the bottom side of a rectangle to the value wwww. wwww is a number between 1 and 4 digits in length. A width of zero causes the bottom line to be suppressed. Note: This command has no effect for corner marker or target fields
SnnLxxxx,yyyy	Set the Length parameter of Graphic Field nn to the value xxxx for the x direction and to the value yyyy for the y-direction. xxxx and yyyy are numbers between 1 and 4 digits in length. For Corner Markers, Length is the distance in pixels each marker extends from each corner. For the Target Marker, length is the length in pixels of the horizontal and vertical lines and has a resolution of 2 pixels so that the Target Marker is always symmetrical with ½ the length on each side of the center point.
SnnLaaaa	Sets the Length parameter of Graphic Field nn to the value aaaa for both x and y directions. aaaa is a number between 1 and 4 digits in length.
SnnKcs	For Layer 1, set the control parameters for Graphic Field nn. c = Parameter identifier, referenced by letter, from A to H inclusive s = 1 to enable the function, or 0 to disable For Corner Marker Fields, parameter A = suppress top-left marker parameter B = suppress bottom-left marker parameter C = suppress top-right marker parameter D = suppress bottom-right marker
SnnImmmm	For Layer 1, set the image number for Graphic Field nn to the value mmmm.
SnnT"ASCII text"	For Layer 1, set the ASCII text string for Graphic Field nn. The text string is used when the Field type is set to Text. "ASCII text" is the content of the string framed with quotation marks.
SnnFfff	For Layer 1, set the font & size for Graphic Field nn. fff is a number of between 1 and 3 digits in length. Refer to Table 10: Text and Symbol Fonts for the list of choices. The default for 720p and 1080p is font 1 and 2 respectively.

Command Code	Mode of Operation
SnnPAxxxx,yyyy SnnPBxxxx,yyyy	For Layer 1, set location coordinates for Graphic Field nn. Each Field has two location coordinates referenced by letter, either 'A' or 'B'. Coordinate A is the top-left position of a Rectangle Field, Text Field, or Corner Marker Field, and is the center position of a Target Marker Field. Coordinate B is the bottom-right position of a Rectangle Field or Corner Marker Field. xxxx and yyyy are numbers between 1 a 4 digits in length.
SnnXxxxx	For Layer 1, set the x-direction position for coordinate A of the Graphic Field nn. This command is included for compatibility with the Text Overlay command set.
SnnXaaaa,bbbb	For Graphic Field nn on Layer 1, set the x-direction position for coordinate A to the value aaaa and set the x-direction coordinate B to the value bbbb.
SnnYyyyy	For Layer 1, set the y-direction position for coordinate A of the Graphic Field nn. This command is included for compatibility with the Text Overlay command set.
SnnYaaaa,bbbb	For Graphic Field nn on Layer 1, set the x-direction position for coordinate A to the value aaaa and set the x-direction coordinate B to the value bbbb.
SnnPAXxxxx SnnPBXxxxx	For Graphic Field nn on Layer 1, set only the x-direction location of either coordinate A or coordinate B.
SnnPAYyyyy SnnPBYyyyy	For Graphic Field nn on Layer 1, set only the y-direction location of either coordinate A or coordinate B.
SnnNm	For Graphic Field nn, set the justification mode. These commands use the field length that is set separately by the SnnJmm command. m = 0 No justification is selected m = 1 Display the text string left justified in the field. If the string is longer than the field, it is clipped at the right. If the string is shorter than the field it is padded with spaces at the right. m = 2 Display the text string right justified in the field. If the string is longer than the field, it is clipped at the left. If the string is shorter than the field, the string is padded with spaces at the left. m = 3 Display the text string right justified in the field. If the string is longer than the field, the field expands to fit the string. If the string is shorter than the field, the string is padded with spaces at the right. m = 4 Display the text string centered in the field. If the string is longer than the field, it is clipped at the left. If the string is shorter than the field, it is padded with spaces before and after to center it.
SnnJmm	For Graphic Field nn, set the field length to mm characters for justification. If the field length is 0, justification is disabled.

Table 14: Graphic Layer 1 Low Level Overlay Commands

Command Code	Mode of Operation
Graphic Layer 1 Low Level Overlay Commands	
SB	Renders the graphic fields of the active layer to the spare buffer, but the buffers are not swapped. The video output does not change.
SW	Swap the active and spare buffers on the active graphics layer, and then clear the new spare buffer. No fields are rendered and the spare buffer is displayed with its existing content.
SS	Swap the active and spare buffers on the active graphics layer without rendering and fields or clearing of any buffers
SC	For the active graphics layer, clear the spare buffer
SnU SnnU	For the active graphics layer, render only the field number specified to the spare buffer.

4.8.1.12 Frame Counter Overlay SERIAL Commands

The DX-2200-TI has a Frame Counter that displays the frame number on *Graphic Layer 1* of the output video. The count of the Frame Counter is based on the number of video frames output from the unit.

4.8.1.12.1 FRAME COUNTER DISPLAY MODE

The main function of the Frame Counter is to display an automatically incrementing count on the video. The frame counter can display a count that increments on each video frame, formatted as either an integer, or as HH:MM:SS:FF where FF is the frame number. It can also display the time from a clock that is independent of the video, formatted as HH:MM:SS with 0 to 3 decimal places for seconds. The DX-2200 does not have a battery backed up real time clock; therefore the time and frame counts are lost when the unit is powered down or reset. If the frame count needs to be set to real time, or some other specific starting value, then an external controller must send a Serial Command to the DX-2200 after power up to set the count. The time can also be obtained from a GPS receiver attached to the DB9 serial port.

The Frame Counter has 9 modes of operation that are selectable using the SFMn command (See Table 15).

4.8.1.12.1.1 Frame Counter Mode 0

Frame Counter Mode 0 turns off the frame count display. When the automatic counter is off, it is possible to send ASCII text and display it on the video by Serial Command. This mode supports writing short custom strings at a high frame rate. If the external controller can send commands synchronized with video frames, it is possible to draw at frame rate.

4.8.1.12.1.2 Frame Counter More 1

Frame Counter Mode 1 is a counter formatted as 'HH:MM:SS:FF', where FF is the frame number. For frame rates of 29.97 and 59.94 Hz, the frame counter implements drop frame timecode by default so that the frame counter displayed as time (Mode 1) tracks with real time. It is possible to disable drop frame timecode using the SCF0 command. For all other video frame rates, the counter counts from 00 to the number of frames per second minus one.

4.8.1.12.1.3   Frame Counter Modes 2 – 4

Frame Counter Mode 2, 3, and 4 displays the frame count as a four digit 'NNNN', a six digit 'NNNNNN', or an eight digit 'NNNNNNNN' number with leading zeroes. The count increments on every output frame and will reset to 0 when all digits are '9'.

4.8.1.12.1.4   Frame Counter Modes 5 – 8

Frame Counter Mode 5, 6, 7, and 8 are the time clock modes and display a 24 hour clock in the format HH:MM:SS, HH:MM:SS.S, HH:MM:SS.SS and HH:MM:SS.SSS respectively.

NOTE: The time shown in the time clock display was the time sampled from the clock at the time text was being drawn into the frame buffer and does not accurately represent the time of an external event such as start of frame entering or leaving the DX-2200.

4.8.1.12.2 FRAME COUNT VALUE

The Frame Count can be set to a specific value at any time using Serial Commands.

The current frame count for Mode 1 can be set using the SFT:HH:MM:SS command. The current frame count value used in Modes 2, 3 and 4 can be set by the SFNnnnn command. For the time clock modes, use the command SFR:HH:MM:SS.SSS to set the time.

The three count values are independent of each other. All counters start at zero when the DX-2200 is powered on or reset. The frame counts for modes 1 to 4 continue to be updated when the counter is not displayed, but will pause when the video mode is switching and will lose sync with real time. The time clock modes (modes 5 to 8) are not affected by the video and will always continue to count.

4.8.1.12.3 FRAME COUNTER APPEARANCE

Commands are provided to configure the position, color, transparency and font of the Frame Counter.

The default text properties for the Frame Counter are:

Foreground: Red = 255, Green = 255, Blue = 255, Transparency = 000
Background: Red = 000, Green = 000, Blue = 255, Transparency = 255
Position: X = 0, Y = 0

The syntax for the commands (see Table 15) that configure the appearance of the Frame Counter is similar to those used by the Text Overlay Commands. Many of the commands include a Field number (nn). The Field number may be either one or two digits, for example 01 or 1. Only field number 1 is supported by the Frame Counter. All other values reserved for future use.

The Field numbers used by the Frame Counter commands are independent of those used by the Text Overlay. This means that Text Overlay Field 1 can still be used normally when the Frame Counter is operating.

The fonts used by the Frame Counter are different than those used in the Text Overlay. All Frame Counter fonts are fixed width and hard edge. The available font and size options are listed in the command table (see Table 15). Setting the font to 000 selects the default font which is dependent on the video mode. To ensure the frame counter is drawn at the video rate, it is recommended not to use a font larger than the default font.

When the appearance of the frame counter is changed while the counter is visible, a frame will be generated that has no frame count displayed while the parameters are being changed. Unlike the Text Overlay Commands, the Frame Counter Commands take effect immediately.

Note: The blending of transparent text and text background differs between the Frame Counter and the Text Overlay Fields. When the same parameters are used, the appearance may not match. For Text Overlay Fields, partly transparent text blends with the text background color and if the background is

not fully visible, it also blends with the underlying image. For the Frame Counter, partly transparent text does not blend with the frame counter background color.

4.8.1.12.4 MANUAL MODE

When the Frame Counter mode is set to 0 the automatic frame count display is turned off. In this case, an ASCII string can be assigned to the Frame Counter Field using the SF01T command. The text can then be drawn using the SFnnD command, or cleared using the SDnnH command. These commands render the text to the active frame buffer instead of the spare buffer. In some applications it is possible to display a short text string at higher speed using this mode than would be possible with the Text Overlay Commands.

The Frame Counter and the Text Overlay use the same active and spare frame buffers. If Text Overlay Commands cause the spare and active buffers to switch, any text that was drawn into the active buffer with the SFnnD command will no longer be visible. To display the text again, the 'SF1D' must be used to redraw the text in the new active buffer.

Notes:

1) If the configuration is saved to flash, any text that has been by displayed using the Frame Counter in Manual mode will not be restored when the unit powers up. Only text fields displayed using the Text Overlay Commands will be restored.

2) After receiving the SFnnD, the Frame Counter will render text beginning after the frame buffer has completed output of the video lines where the text will be located. If other commands are received prior to rendering that change the text parameters or Frame Counter mode, the text will be rendered with the new parameters or rendering may be cancelled by the new commands. Control software that sends commands to the unit should include appropriate delays after sending the SF1D command to allow drawing to complete before changing the Frame Counter parameters.

4.8.1.12.5 EXAMPLES OF FRAME COUNTER COMMANDS

4.8.1.12.5.1 Example 1: Frame Counter

Starting with DX-2200-TI using the factory defaults, turn on the frame counter in the upper left corner of the screen with white text on a blue background and set the current frame counter value to 11:25:00

```
SF1BA000
SFT:11:25:00
SFM1
```

4.8.1.12.5.2 Example 2: Frame Counter

Show the message "Frame Counter (hh:mm:ss:ff)" in the top left corner of the video and show the frame counter below it. The text properties are set for yellow text on a blue background for both.

```
S1X50
S1B0
S1BA0
S1T"Frame Counter (hh:mm:ss:ff)"
S1S
SF1Y50
SF1X50
SF1B0
SF1BA0
SFM1
```

Figure 20: Frame Counter text display – Example 2

4.8.1.12.5.3   Example 3: Frame Counter

Show the message "Frame Count" in the top left corner of the video and show the frame counter below it. The text properties are set for default white text with no background.

    S1F008
    S1X0050
    S1T"Frame Count"
    S1S
    SF1Y0045
    SF1X0050
    SFM4

Figure 21: Frame Counter text display – Example 3

Table 15: Frame Counter Overlay SERIAL Command Codes

Command Code	Mode of Operation
Frame Counter Overlay Commands	
SFMn	Control the frame counter operating mode 0 – Off / Manual Drawing 1 – Frame Counter 'HH:SS:MM:FF' 2 – Frame Counter 'NNNN' 3 – Frame Counter 'NNNNNN' 4 – Frame Counter 'NNNNNNNN' 5 – Time Clock 'HH:MM:SS' 6 – Time Clock 'HH:MM'SS.S' 7 – Time Clock 'HH:MM:SS.SS' 8 – Time Clock 'HH:MM:SS.SSS'
SFZ	Reset all fields to the default text, size, position, color and font.
SnnZ	Reset text field nn to the default text, size, position, color and font. nn - the one or two digit Text Field / String number to modify.
SFnnXxxxx	Set the X position - xxxx must be a number between 1 and 4 digits in length. nn - the one or two digit Text Field / String number to modify. Set nn equal to 1 to control the position of the frame counter. If the position places some or all of the text off screen, the text is positioned so that the end of the text is at the right edge of the video.
SFnnYyyyy	Set the Y position - yyyy must be a number between 1 and 4 digits in length. If the position places the text off screen, then the text is placed at the bottom of the video.
SFnnRrrr	Set the Red color value of string nn - rrr must be a number between 1 and 3 digits in length and in the range 000 and 255.
SFnnGggg	Set the Green color value of string nn - ggg must be a number between 1 and 3 digits in length and in the range 000 and 255.
SFnnBbbb	Set the Blue color value of string nn - bbb must be a number between 1 and 3 digits in length and in the range 000 and 255.
SFnnAaaa	Set the transparency of string nn - aaa must be a number between 1 and 3 digits in length and in the range 000 and 255. The value 0 sets the string fully visible and 255 is fully transparent.
SFnnBRrrr	Set the Red color value of the background for string nn - rrr must be a number between 1 and 3 digits in length and in the range 000 and 255.
SFnnBGggg	Set the Green color value of the background for string nn - ggg must be a number between 1 and 3 digits in length and in the range 000 and 255.
SFnnBBbbb	Set the Blue color value of the background for string nn - bbb must be a number between 1 and 3 digits in length and in the range 000 and 255.
SFnnBAaaa	Set the transparency of the background for string nn - aaa must be a number between 1 and 3 digits in length and in the range 000 and 255.The value 255 sets the background fully transparent and the value 0 sets the background fully visible.

Command Code	Mode of Operation
SFnnFxxx	Set the font where xxx is the font number. The font number must be between 1 and 3 digits in length. The following fonts are available: 1 – Larable Bold 26 pixel height 2 – Larable Bold 40 pixel height 3 – BGP Courier 26 pixel height 4 – BGP Courier 40 pixel height 5 – Tahoma Bold 26 pixel height 6 – Tahoma Bold 40 pixel height xxx= 0 selects the recommended default font. xxx= 1 selects a 26 pixel font recommended for NTSC / PAL / 720p xxx= 2 selects a 40 pixel font recommended for 1080i / 1080p **Note:** Using the Frame Counter with a larger font than recommended may result in slower updates and/or video frames with partially drawn count values.
SFm	Update mode. The Text Overlay and Frame Counter use the same video frame memory. This command affects the update sequence when the Text Overlay performs a buffer swap. SF0: The Text Overlay swaps buffers immediately when it has completed rendering text or is commanded to so. This mode provides fast response to the Low Level Text Overlay buffer swap commands, but will often result is a frame without the frame count displayed after the buffer switch. SF1: The Text Overlay buffer swap is delayed while the frame count is drawn into the new buffer before the buffers are switched. This avoids a frame without the frame the frame counter display, but delays the buffer switch. This is the factory default setting.
SFC1	Enable drop frame timecode for 29.97 and 59.94 frames per second modes. Drop frame timecode is enabled by default.
SFC0	Disable drop frame counting for 29.97 and 59.94 frames per second modes.

SFT:HH:MM:SS
or
SFT:HH:MM:SS:FF
	Set the value of the frame counter for Mode 1, for example to match local time. Where:
	  HH is the two digit number of hours from 00 to 23
	  MM is the two digit number of minutes from 00 to 59
	  SS is the two digit number of seconds from 00 to 59
	  FF is the two digit frame number from 00 to [frame per second -1]
	If the command without FF is used, the frame number will be set to 00.

SFR:HH:MM:SS
SFR:HH:MM:SS.S
SFR:HH:MM:SS.SS
SFR:HH:MM:SS.SSS
	Set the value of the time clock frame counter for Modes 5, 6, 7, and 8. Where:
	  HH is the two digit number of hours from 00 to 23
	  MM is the two digit number of minutes from 00 to 59
	  SS is the two digit number of seconds from 00 to 59
	The command can optionally include between 1 and three decimal places for seconds.

SFNnnnnnnnn	Set the value of the frame counter for modes 2, 3, and 4. nnnnnnnn is a positive integer of between 1 and 8 digits.
SFnnT"text"	Set the text string used in Manual Drawing mode. "text" is the string enclosed in quotation marks.
SFnnD	Draw the text string. This command is valid only in Manual Drawing Mode.
SFnnH	Erase the text string by drawing it with 100% transparency. This command is valid only in Manual Drawing Mode.

4.8.1.13 Layer Control SERIAL Commands

The Layer Control SERIAL Commands allow layers to be updated, reduced in size, and moved. These commands also duplicate some of the capabilities provided in the Text Overlay and Graphics Overlay commands.

These commands include one or more layer numbers that are represented by 'nnn' in the command descriptions. It is possible to specify a single layer, two layers, or three layers by combining layer numbers in the command.

The layers are:

    0 – Apply the command to all layers

    1 – Graphics Layer 1

    2 – Graphics Layer 2

    3 – Graphics Layer 3

For example the LnnnU command updates layers:

    L1U   – Update layer 1
    L12U   – Update Layers 1 and 2
    L123U   – Update all Layers (1, 2 and 3)
    L0U   – Update all Layers (1, 2 and 3)

NOTE: When specifying layers, do not specify the same layer number more than once, and do not combine '0' with any other layer number.

4.8.1.13.1 LOW LEVEL BUFFER CONTROL

The Layer Control Serial Commands can be used to access the same Low Level Overlay Functions that are provided in the Text Overlay and Graphic Overlay Commands. In the case of the Graphic Overlay Commands, it may be more convenient to use these commands because the layer number is included in the command as a parameter to allow the command to be executed without need of changing the active graphics layer.

The Low Level Buffer Control Commands are LnnnB, LnnnW, LnnnC, and LnnnS. When nnn is 1, these commands are equivalent to the SW, SW, SC, and SS commands.

When n is 2 or 3, the commands are equivalent to the GB, GW, GC, and GS commands with the Active Layer set to n.

4.8.1.13.2 VISIBILITY OF LAYERS

Individual layers can be enabled and disabled at the mixer. This provides a high speed method of turning a layer on and off because the individual fields don't need to be rendered.

The LnnnD command disables the visibility of a layer, and the LnnnE command enables visibility. The LnnnT command toggles visibility on and off.

These visibility commands act as a master control to enable or disable the entire layer. The visibility settings of the individual Fields on the layer are not changed by these commands. By default, all layers are enabled.

NOTE: If these commands are used to disable a layer, then the visibility commands for the individual Fields on that layer cannot make them visible again. Only the LnE command or resetting the layer to defaults can make them visible

4.8.1.13.3 ENABLING AND DISABLING LAYERS

If one or more layers are not required in an application, they can be disabled using the LnnnH command. Layers that have been disabled can be re-enabled using the LnnnA command. In some circumstances, disabling layers that are not used can improve update performance on the remaining layers.

These commands are relatively slow and may disturb the output video. They are recommended for use during initial setup or at times when clean video output is not required.

4.8.1.13.4 RE-SIZING OVERLAYS

By default, all overlay layers are the same size as the video output of the DX-2200-TI. The LnnnKxxxx,yyyy command sets a preferred size for the overlay. If the preferred size is smaller than the video size, the overlay is reduced in size to match the preferred size. The overlay will never be larger than the output video size.

When the overlay size is changed, the layer will be disabled momentarily and both the active and spare frame buffers will be cleared. To see the content of the overlay after a size change the layer must be updated, for example using the LnU command.

Setting xxxx and/or yyyy to 0 restores the default overlay size. It is not possible to set the overlay width or height smaller than 16 pixels. For any of the interlaced video modes, the height of the overlay must be an even number of pixels and will be automatically rounded up if necessary.

4.8.1.13.5 MOVING AN OVERLAY

When an Overlay has been reduced in size, (via the LnnnKxxxx,yyyy command) it is then possible to change the x, y position of the overlay item within the boundaries of the output video. This process can then be used for moving/panning an OSD target marker around the displayed video.

The LnnnPxxxx,yyyy sets the x and y position of the overlay. The overlay must always fit completely within the boundaries of the output video. It is not possible to have an overlay partially off screen. This is the reason that the overlay must be reduced in size before the position can be changed. It is also possible to change only the x position using the LnnnPXxxxx command, or only the y position using the LnnnPYyyyy command.

By default, the overlay position coordinates refer to where the top-left corner of the overlay is located in the output video. The reference point can be changed to the center of the overlay instead of the top left corner using the LnnnPM2 command.

Moving the overlay is very fast because it does not require rendering any Fields or switching the overlay buffers. The overlay item can be repositioned at the video frame rate by sending Serial Commands at an appropriate interval.

Table 16: Layer Control SERIAL Command Codes

Command Code	Mode of Operation
Layer Control Commands	
LnnnU	Update layer nnn by rendering all Fields on the layer(s) to the spare buffer, then switching the spare and active buffers to make the update visible. nnn is the layer number(s), See ** After the buffer switch, the new spare buffer is automatically cleared.
LnnnB	Renders the Text or Graphics Fields on Layer(s) nnn to the spare buffer, but the buffers are not swapped. The video output does not change. nnn is the layer number(s), See **

Command Code	Mode of Operation
LnnnW	Swap the active and spare buffers on layer n, then clear the new spare buffer. No fields are rendered and the spare buffer is displayed with its existing content. nnn is the layer number(s), See **
LnnnS	Swap the active and spare buffers on Layer n without rendering and fields or clearing of any buffers. nnn is the layer number(s), See **
LnnnC	Clear the spare buffer on Layer n. n is a number in the range 0 to 3, See **
LnnnD	Disable display of Layer n. The entire layer is disabled without changing the settings of any Text or Graphic Fields on that layer. Use LnE to make the layer visible again. nnn is the layer number(s), See **
LnnnE	Enable display of Layer n. If the layer was previously disabled with LnD, then this command makes the layer visible again. The LnD and LnE commands provide a very fast method of turning an entire layer on and off. nnn is the layer number(s), See **
LnnnH	Disable layers that are not needed. Note: This command may disturb the output video.
LnnnA	Enable a layer that has been previously disabled with LnnnH. Note: This command may disturb the output video.
LnnnT	Toggle the visibility of Layer n between on and off. nnn is the layer number(s), See **
LnnnZ	Set the size and visibility of Layer n to default. The defaults are visible and the same size as the output video of the DX-2200-TI-03. nnn is the layer number(s), See **
LnnnKxxxx,yyyy	Set a preferred size for an overlay layer. xxxx and yyyy are numbers between 1 and 4 digits in length. The size of an overlay cannot be less than 16 pixels in either direction. Setting xxxx=0 and/or yyyy=0 uses the default size, which is the same size as the output video. nnn is the layer number(s), See **
LnnnPxxxx,yyyy	Set the x and y position of the overlay for Layer n. xxxx and yyyy are numbers between 1 and 4 digits in length. The overlay must always fit completely within the output video and the position specified in this command is automatically adjusted to prevent the overlay extending beyond the edges of the video. Therefore, if the overlay is at the default size (the same size as the output video) it can only be positioned in one location and this command will have no effect. The overlay can only change positions if the size has been reduced to be smaller than the output video size. nnn is the layer number(s), See **
LnnnPXxxxx	Set the x-direction position only for overlay Layer n. nnn is the layer number(s), See **
LnnnPYyyyy	Set the y-direction position only for overlay Layer n. nnn is the layer number(s), See **
LnnnPM1	Set the position coordinates for layer n to be specified as top-left corner of the overlay nnn is the layer number(s), See **

Command Code	Mode of Operation
LnnnPM2	Set the position coordinates for the layer n to be specified as center position of the overlay. nnn is the layer number(s), See **

** The layer number nnn is a 1 to 3 digit number specifying one or more layers:

    n = 0 – Apply to all Layers (Graphics Layer 1, Graphics Layer 2, Graphics Layer 3)
    n = 1 – Graphics Layer 1
    n = 2 – Graphics Layer 2
    n = 3 – Graphics Layer 3

4.8.1.14 User Interface Commands

The user interface commands control the behavior of the DX-2200-TI and allow reconfiguration of the functions performed by the DIP switch and toggle switch to customize the product for specific applications.

Configuration of the switches consists of two steps. The switch(s) to be configured are assigned to a user interface function, and the user interface function is programmed to perform the required operations.

The DX-2200-TI has 4 DIP switches and one momentary contact toggle switch that toggles both left and right. Different commands are used to assign the DIP and toggle switches.

4.8.1.14.1 DIP SWITCH ASSIGNMENTS

DIP Switch Assignments DIP switches are assigned to user interface functions using the 'US' commands.

An assignment command example is US1:01. This command will assign DIP Switch #1 to control user interface function 01.

One or more DIP Switches can be assigned to the same user interface function. The number of switches assigned determines how many different operations can be selected from the user interface function. When one switch is assigned, two operations are available. Two switches allow four operations, three switches allow eight operations and four switches allow the selection of 16 operations.

The factory default settings for the Toggle Switch are listed in Table 24: Operation of 2-Position Momentary Toggle Switch and for the DIP Switch, Table 25: Operation of the 4-Position DIP Switch.

4.8.1.14.2 TOGGLE SWITCH ASSIGNMENTS

Toggle switch supports two functions: a toggle right or a toggle left function which are assigned using the UR and UL commands respectively. The assignments can apply either to all modes of operation, or to one specific mode. For example command: UR:03 will set toggling the Toggle Switch to the right to control user interface function 03.

4.8.1.14.3 USER INTERFACE FUNCTION CONFIGURATION

The user interface functions are software components that have a selection input that is controlled by the physical Switches that are assigned to it. For each value of the selection input, a different Serial Command string can be assigned.

The DX-2200-TI has 20 user interface functions numbered 01 through 20. Each user interface function supports up to 16 selections that are numbered 00 to 15. In the factory default configuration, all user interface functions are unused and have no commands assigned to them.

The switches that control a user interface function can be either one or more DIP Switches, or a Toggle Switch.

If DIP Switches have been assigned, then the value set on the Switches determines the selection. Each Switch that has been assigned becomes one bit of the selection value, with the least significant bit being the Switch with the lowest number (as marked on the DIP switch component). When a Switch is OFF, the bit value is 0. When the Switch is on, the bit value is 1.

If a Toggle Switch has been assigned, then the Switch increments the selection each time it is toggled, until a selection is found with no command assigned, or the maximum number of selections has been reached. This indicates the end of the Toggle Switch function loop and the selection is reset to 0.

4.8.1.14.3.1   User Interface Commands

The UF commands are used to assign commands to the user interface functions. For example, the command UF07,00:"S1V" assigns user interface function 07 selection number 00 to perform the command S1V (toggle the visibility of Text Field 1). Any previous command assignment for this user interface function and selection is erased by this command.

The command string that is being assigned is always enclosed with quotation marks. More than one command can be assigned in the above command using a semicolon delimiter. For example UF07,00:"S1V;S2V" will toggle the visibility of Text Field 1 and 2.

Another version of the UF command supports appending additional commands to a selection that already has a command assigned. The command UF07:00+"S3V", executed after the previous example, adds the command S3V to the previous commands.

Executing UF07,00:"" clears any command that was previously assigned to Selection 00 of user function 07.

When executing the UF commands, the command response (either '+' or '-') indicates only that the syntax of the UF command was accepted. It does not indicate the command string being assigned to the user interface function is correct. Commands can be tested by executing them prior to assigning them to user interface functions.

4.8.1.14.4 RESETTING TO FACTORY DEFAULT CONFIGURATION

The DX-2200-TI provides commands to clear the user functions and restore the default switch settings. All selections of a user functions can be cleared using the UFnnC command where nn is the user function number. All user functions can be cleared with the UFC command. The UR command restores the default DIP and Toggle switch settings, but does not clear any user interface functions that the user has configured.

4.8.1.14.5 RECOMMENDATIONS FOR CONFIGURATION

Assign either one set of DIP switches, or one toggle switch to a user interface function. Assigning more than one toggle switch, or both DIP and toggle switches to the same function will usually have undesirable results.

Don't assign Toggle Commands to DIP switches. For example, don't assign 'S1V' to a DIP switch. Use 'S1S' and 'S1H' instead to show or hide a text field.

Table 17: User Interface Command Codes

Command Code	Mode of Operation
User Interface commands	
USn:ff	Assign DIP switch number n to user interface function ff for all operating modes. n must be one digit and ff must be two digits.
USnMmm:ff	Assign DIP switch number n to user interface function ff for operating mode mm only. The assignments for other modes remain unchanged. ff and mm must both be two digits.

UL:ff UR:ff	Assign toggle left or toggle right to user interface function ff in all modes of operation. ff must be be two digits
ULMmm:ff ULMmm:ff	Assign toggle left or toggle right to user interface function ff in mode mm only. ff and mm must both be two digits.
UFff,ss:"str"	Assign a command string to user interface function ff, selection ss where both ff and ss must be two digits. Any previous command is erased.
UFff,ss+"str"	Append additional commands to the command string for user interface function ff, selection ss where both ff and ss must be two digits.
TL TR	Perform the toggle left or toggle right operation as if the switch had been toggled.
TLnn TRnn	Set the toggle left or toggle right loop position to setting nn where nn may be either one or two digits.
UR	Reset the DIP and toggle switches to perform the factory default functions.
UFC	Clear the commands from all selections of all user interface functions
UFnnC	Clear the commands from all selections of user interface function nn, where nn is two digits.
TD	Disable the toggle switch. Toggling the switch will have no effect, but the TL / TR commands will continue to function.
TE	Enable the toggle switch
UD	Disable the DIP switches.
UE	Enable the DIP switches
UU	Read the DIP switches immediately and execute the commands for the current setting.
U0	DIP switch settings are applied only when the DIP switches are changed. This mode may be useful when the DX-2200 is operating primarily under SERIAL control, but the DIP switches are also being used.
U1	DIP switch settings are applied when the DIP switches are changed, at startup, and also whenever the mode is changed. This is the default mode of operation.
U2	DIP switch settings are applied when the switch is changes and also at startup if there is no saved configuration in the unit. This is the default setting of the DX-2200-TI

4.8.1.14.6 EXAMPLE CONFIGURATION COMMAND FILE

The following is an example DX-2200-TI Configuration Command File that can be uploaded to the unit using a terminal program. The example assigns dip switch 4 to change the transparency of the SDI input and assigns the toggle right function to loop through a list of preset text messages.

```
' ------------------------------------------------------------------------------------
' DX-2200-TI  - Sample of a MANUAL control mode configuration script
'
' The dip switches and toggle switch on the unit can be re-defined to
' customize the controls to provide the functions needed in specific
' user applications.
' This script is an example of how the product can be configured
```

' using SERIAL commands.

'

' Note: all lines starting with ' can be transmitted to the DX-2200-TI

' and will be ignored as comments)

' --'

'

' Reset the user interface to factory default

UR

'

' clear any previous text field settings

SZ

'

' Assign Dip Switch 4 to set the Input SDI video 75% transparent.

US4:01

UF01,00:"a0"

UF01,01:"a6"

'

' Assign commands to configure Text Field parameters to user function 02.

'

uf02,00:"S1Z;S1T\"Message #1 (Font 001, Yellow)\";s1f003;S1B000;S1X0100;S1Y0100;S1S"

uf02,01:"S1Z;S1T\"Message #2 (Font 002, Green)\";s1f002;S1R000;S1B000;S1X0100;S1Y0200;S1S"

uf02,02:"S1Z;S1T\"Message #3 (Font 003, Blue)\";s1f001;S1R000;S1G000;S1X0100;S1Y0300;S1S"

uf02,03:"S1Z;S1T\"Message #4 (Background+Transparency)\";S1A128;S1BA128;S1X0100;S1Y0400;S1S"

uf02,04:"S1Z;SU"

' Terminate the list of commands

uf02,05:"";

'

' Assign toggle right to perform user function 02.

UR:02

4.8.1.15 GPS Receiver Support

The DX-2200-TI can receive NMEA 0183 data sentences from an external GPS receiver attached to the DB9 Serial Port. Data items from the GPS are stored in dedicated data fields in the product. By sending commands to the DX-2200, it can be configured to use contents of selected data fields to set the text string for specified Graphic Fields. The usual Graphic Field commands for visibility, font, color, position, etc. determine how the data is displayed on the overlay. This allows the DX-2200 to overlay information such as date, time, and position.

The text content of the Graphic Fields are automatically updated each time new data is received from the GPS. After the DX-2200 has been configured, it can continue to operate and update the overlay data without additional commands being sent to the control port.

Additionally, the time received from the GPS can be used to set the frame counter time clock to overlay a higher resolution time display.

The DX-2200 is not compatible with NMEA 2000 devices or USB GPS receivers.

NOTE: GPS receiver support is not available for older DX-2200 products with Rev C or earlier board revisions.

4.8.1.15.1 CONNECTION OF THE GPS RECEIVER

The DB9 connector on the DX-2200 has a custom configuration with two independent serial ports. The first port, placed at the standard pin locations (pins 2 & 3) is the Control Port of the DX-2200. The second port,

placed at pins 7 & 8 is the GPS port. Refer to Table 18: DB9 Serial Y Splitter Cable Pin Connections and Table 30: RS-232 Serial Port DB9 Pin Assignments for the pinout of the DB9 connector.

The DB9 Serial Y Splitter Cable, part number W6001, is available to attach to the DX-2200 DB9 connector and provide two separate DB9 (female) sockets with one port on each connector. This cable may provide a more convenient connection of the Control Port device and also the GPS to the DX-2200. The cable is not supplied standard with the DX-2200. It must be ordered separately.

Figure 22: DB9 Serial Y Splitter Cable (Part # W6001)

GPS receivers will typically not have the required DB9 connector attached to the data cable and it will be necessary to install the connector. The wiring of the GPS receiver to the DX-2200 will depend on the model of GPS receiver that is used. Refer to the GPS receiver documentation for details.

Table 18: DB9 Serial Y Splitter Cable Pin Connections

DB9 (Male) Pin	DX-2200 Signal Direction	Function	DB9 (Female) Connection
2	DX-2200 TxD Output	Control Port	COM1 pin 2
3	DX-2200 RxD Input	Control Port	COM1 pin 3
5	-	Signal Ground	COM1 & COM2 pin 5
7	DX-2200 RxD Input	GPS Port	COM2 pin 3
8	DX-2200 TxD Output	GPS Port	COM2 pin 2

An example connection is shown in Figure 23 for the Garmin GPS18x LVC Receiver. The example uses the COM Port DB9 Serial Y Splitter cable. Note that if the splitter cable is not used and the GPS receiver is wired directly to the DB9 on the DX-2200 instead, different pin numbers must be used. Instead of wiring the green and white wires to pins 2 & 3, use pins 8 & 7. (Refer to Table 30: RS-232 Serial Port DB9 Pin Assignments.)

The DX-2200 does not provide power for the GPS, therefore an external power source or battery operated GPS will be required.
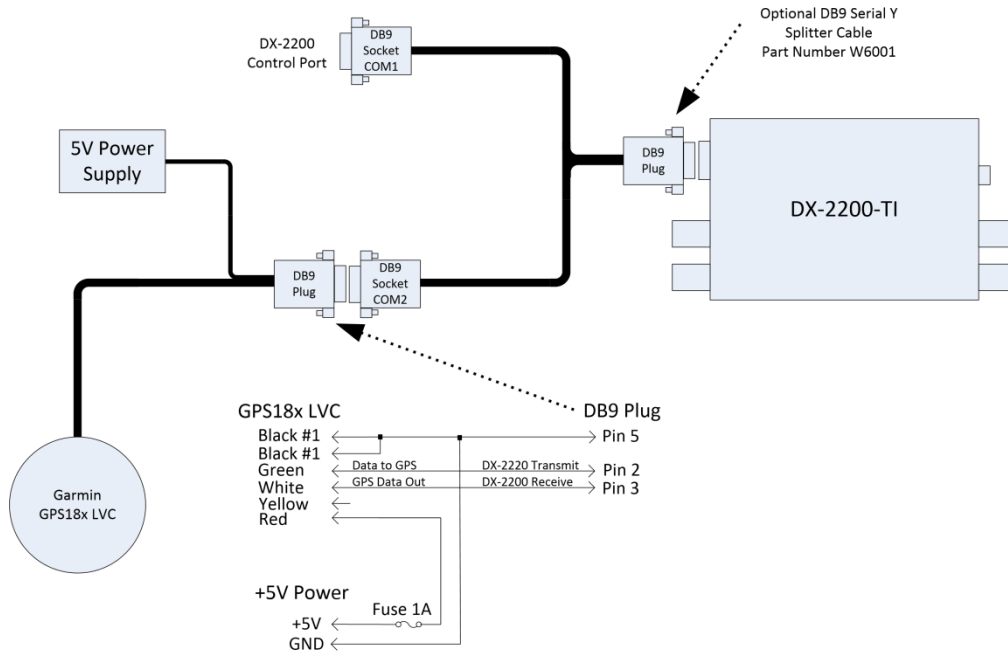
Figure 23: Connection of Garmin GPS18xLVC

4.8.1.15.2 GPS DATA CAPTURE

The DX-2200 will capture data from the following NMEA 0183 sentences: $GPGGA, $GPRMC, $GPGLL, $PGRMF, $GPVTG, $GPGSA, GPGSV, $PGRMV, $PGRME, and from Garmin proprietary sentences $PGRMT, and $PGMID.

Table 19 lists the data fields that are captured by the DX-2200 and the NMEA 0183 sentences that provide the data. If the GPS has not been configured to output one or more of the sentences for a data field, then that field will contain an empty string. Refer to the instruction manual of your GPS to determine how to configure it to provide the required sentences.

Refer to the NMEA 0183 standards or your GPS instruction manual for more information about the data format of your GPS.

Table 19: GPS Data Fields

Field Number	Description	NMEA 0183 Sentence(s)
1	UTC time of position fix	$GPGGA $GPRMC $GPGLL $PGRMF
2	UTC date of position fix	$GPRMC $PGRMF
3	Latitude	$GPGGA $GPRMC $GPGLL $PGRMF
4	Latitude hemisphere	$GPGGA $GPRMC

Field Number	Description	NMEA 0183 Sentence(s)
		$GPGLL $PGRMF
5	Longitude	$GPGGA $GPRMC $GPGLL $PGRMF
6	Longitude hemisphere	$GPGGA $GPRMC $GPGLL $PGRMF
7	Speed over ground (Knots)	$GPRMC $GPVTG
8	Speed over ground (KPH)	$GPVTG $PGRMF
9	True course over ground	$GPRMC $GPVTG
10	Magnetic course over ground	$GPVTG
11	Antenna height above or below mean sea level (m)	$GPGGA
12	Geoidal height (m)	$GPGGA
13	GPS quality indication	$GPGGA
14	Satellites in use	$GPGGA
15	Horizontal dilution of precision	$GPGGA $GPGSA
16	Position dilution of precision	$GPGSA
17	Time dilution of precision	$PGRMF
18	Vertical dilution of precision	$GPGSA
19	Fix Type (1/2/3)	$GPGSA
20	Status (A=Valid / V = NAV)	$GPRMC $GPGLL
21	Magnetic variation (degrees)	$GPRMC
22	Magnetic variation direction	$GPRMC
23	Mode Indicator	$GPRMC $GPVTG $GPGLL
24	GPS week	$PGRMF
25	GPS second	$PGRMF
26	Mode (M = Manual / A = Auto)	$PGRMF
27	GPS leap second count	$PGRMF
28	PRN number of satellite used	$GPGSA
29	PRN number of satellite used	$GPGSA

Field Number	Description	NMEA 0183 Sentence(s)
30	PRN number of satellite used	$GPGSA
31	PRN number of satellite used	$GPGSA
32	PRN number of satellite used	$GPGSA
33	PRN number of satellite used	$GPGSA
34	PRN number of satellite used	$GPGSA
35	PRN number of satellite used	$GPGSA
36	PRN number of satellite used	$GPGSA
37	PRN number of satellite used	$GPGSA
38	PRN number of satellite used	$GPGSA
39	PRN number of satellite used	$GPGSA
40	Estimated horizontal error (Meters)	$PGRME
41	Estimated vertical error (Meters)	$PGRME
42	Estimated position error (Meters)	$PGMRE
43	Garmin user defined ID (Garmin Proprietary)	$PGRMID
44	Garmin unit ID (Garmin Proprietary)	$PGRMID
45	Garmin product, model and software version (Garmin Proprietary)	$PGRMT
46	True east velocity	$PGRMV
47	True north velocity	$PGRMV
48	Up velocity	$PGRMV
49	True course over ground (integer)	$PGRMF
50	Fix Type (0 / 1 / 2)	$PGRMF
51	Satellites in view	$GPGSV
52	Position dilution of precision (integer)	$PGRMF
53	Not Used	
54	Not Used	
55	Not Used	
56	Not Used	
57	Not Used	
58	Not Used	
59	UTC Time of position fix (Adjusted by correction applied by DX-2200 CSF command)	$GPGGA $GPRMC $GPGLL $PGRMF
60	Satellite PRN number	$GPGSV
61	Satellite elevation (0 to 90 degrees)	$GPGSV
62	Satellite azimuth (0 to 359 degrees)	$GPGSV
63	Satellite signal to noise ratio (dB)	$GPGSV

Field Number	Description	NMEA 0183 Sentence(s)
64	Satellite PRN number	$GPGSV
65	Satellite elevation (0 to 90 degrees)	$GPGSV
66	Satellite azimuth (0 to 359 degrees)	$GPGSV
67	Satellite signal to noise ratio (dB)	$GPGSV
68	Satellite PRN number	$GPGSV
69	Satellite elevation (0 to 90 degrees)	$GPGSV
70	Satellite azimuth (0 to 359 degrees)	$GPGSV
71	Satellite signal to noise ratio (dB)	$GPGSV
72	Satellite PRN number	$GPGSV
73	Satellite elevation (0 to 90 degrees)	$GPGSV
74	Satellite azimuth (0 to 359 degrees)	$GPGSV
75	Satellite signal to noise ratio (dB)	$GPGSV
76	Satellite PRN number	$GPGSV
77	Satellite elevation (0 to 90 degrees)	$GPGSV
78	Satellite azimuth (0 to 359 degrees)	$GPGSV
79	Satellite signal to noise ratio (dB)	$GPGSV
80	Satellite PRN number	$GPGSV
81	Satellite elevation (0 to 90 degrees)	$GPGSV
82	Satellite azimuth (0 to 359 degrees)	$GPGSV
83	Satellite signal to noise ratio (dB)	$GPGSV
84	Satellite PRN number	$GPGSV
85	Satellite elevation (0 to 90 degrees)	$GPGSV
86	Satellite azimuth (0 to 359 degrees)	$GPGSV
87	Satellite signal to noise ratio (dB)	$GPGSV
88	Satellite PRN number	$GPGSV
89	Satellite elevation (0 to 90 degrees)	$GPGSV
90	Satellite azimuth (0 to 359 degrees)	$GPGSV
91	Satellite signal to noise ratio (dB)	$GPGSV
92	Satellite PRN number	$GPGSV
93	Satellite elevation (0 to 90 degrees)	$GPGSV
94	Satellite azimuth (0 to 359 degrees)	$GPGSV
95	Satellite signal to noise ratio (dB)	$GPGSV
96	Satellite PRN number	$GPGSV
97	Satellite elevation (0 to 90 degrees)	$GPGSV
98	Satellite azimuth (0 to 359 degrees)	$GPGSV
99	Satellite signal to noise ratio (dB)	$GPGSV
100	Satellite PRN number	$GPGSV
101	Satellite elevation (0 to 90 degrees)	$GPGSV
102	Satellite azimuth (0 to 359 degrees)	$GPGSV

Field Number	Description	NMEA 0183 Sentence(s)
103	Satellite signal to noise ratio (dB)	$GPGSV
104	Satellite PRN number	$GPGSV
105	Satellite elevation (0 to 90 degrees)	$GPGSV
106	Satellite azimuth (0 to 359 degrees)	$GPGSV
107	Satellite signal to noise ratio (dB)	$GPGSV

4.8.1.15.3 SELECTION OF DATA FIELDS – THE 'CC' COMMAND

The 'CC' command is used to select a GPS data field and copy it to a Graphic Field for display on the overlay. The data supplied by the GPS is often not formatted appropriately for display. The CC command provides formatting options for specific types of data to convert them into other formats. For example latitude may be provided as "4255.1977" by the GPS. The CC command has an option to convert it to "42° 55.1977'" for display.

The format of the CC command is:

    CCnnFmmMff[Aaaa][Bbbb]

The lower case items represent numbers and the items in brackets are optional or dependent on the formatting method selected. In all cases, nn represents the Graphic Field number that text will be stored in, mm is the GPS data field number to read, and ff is the formatting mode.

The following CC command example sets the text content for Graphic Field 01 and specifies that it should be set using GPS data field 3 (Latitude). Format method 1 is used in this example, which is a simple copy of the GPS data directly to the Graphic Field.

    CC01F3M1

The available formatting options are described in Table 20.

Table 20: Data Formatting for the 'CC' Command

Format Type	Description
1	Copy the GPS Data to the Graphic Field without any formatting changes. No optional parameters are available for this format method. This format mode can be used for any data field. The command syntax is CCnnFmmM1 where, nn is the Graphic Field to set and mm is the GPS data field to copy

2	Copy with leading zero suppression. If the data field contains leading zeros, they are removed when the data is copied to the Graphic Field.
	The command accepts optional parameter A1 that causes the leading zeros to be replaced with spaces instead of being removed.
	This format mode is intended for use with GPS data fields containing a number
	The command syntax is CCnnFmmM1, or CCnnFmmM1A1 where,
	    nn is the Graphic Field to set
	    mm is the GPS data field to copy

Format Type	Description
3	Format time fields. The data field should be time in the format HHMMSS[.s...s]. Using this format option on other types of data will produce incorrect results.
	The format mode can be used without optional parameters to display the time HH:MM:SS[.s...s] with the same number of decimal places as the GPS provided.
	The command supports optional parameter A to specify a number of decimal places between 0 and 3 to display for seconds. If the GPS data field does not contain enough decimal places, zeros will be added. The command syntax is CCmmFnnM3Ad, where d is the number of decimal places to display for seconds.
	For example CC01F01M3A1 copies time to Graphic Field 01 with 1 decimal place for seconds.
	The command supports optional parameter B to specify conversion to 12 hour clock format. The syntax is CCmmFnnM3Bb.
	Parameter b specifies the 12 hour format:
	0 - 12 hour with no am / pm indication
	1 - 12 hour clock and append " am" or " pm"
	2 - 12 hour clock and append " a.m." or " p.m."
	3 - 12 hour clock and append "a" or "p"
	For example CC01F01M3B2 copies the time to Graphic Field 1 with 1 decimal place and converts the time to 12 hour format with " a.m." or " p.m." appended.
	Note: Both the A and B parameters can be combined in the same command.
4	Format time fields for HH:MM display (no seconds). The data field should be in the format HHMMSS[.s…s]. Using this format option on other types of data will produce incorrect results.
	The command syntax is CCmmFnnM4[Bd], where d specified 12 hour clock format as described in format mode 3 above. Optional parameter A cannot be used in this format mode.
	For example CC01F01M4 formats the time as HH:MM, and the command CC01F01M4B0 formats the time as HH:MM with the time converted to 12 hour format and no am / pm indication.
5	Copy a substring from the GPS data field to the Graphic Field.
	The syntax is CCmmFnnM5AfffBnnn where both parameters A and B are mandatory and fff specifies an offset into the GPS data field to start the copy, and nnn specifies a maximum number of characters to copy.
	For example, the command CC01F01M5A0B2 copies the two digit hours from the UTC time of position fix data and places them in Graphic Field 01.
	Note: This command is not useful for GPS data fields that have variable format.
6	Format the GPS data for degrees and minutes display, for example 081° 15.9300'. This format mode should be used on GPS data fields that have a format of [d]ddmm.mm[m..m]
	The syntax is CCmmFnnM6[Afff][Bddd][Cc] where:
	• Optional parameter A specifies an additional field number containing a hemisphere indicator such as 'N', 'S', 'W', or 'E'. The first character of the specified field is copied into the Graphic Field following the degrees and minutes.
	• Optional parameter B specifies a maximum number of decimal places that should be shown for minutes. If the GPS data does not include the requested number of decimal places, they will not be displayed.
	• Optional parameter C specified to suppress leading zeros of the degrees field. C0 drops the leading zeros. C1 converts leading zeros to spaces.
	For example, to set Graphic Field 01 to contain Latitude with the hemisphere indicator, use the command CC01F03M6A4

Format Type	Description
7	Format the GPS data as degrees by displaying the ° symbol after the number. This format type should be used for fields containing a number. The syntax is CCmmFnnM7[Aa], where optional parameter A0 causes leading zeroes to be dropped and parameter A1 causes leading zeros to be converted to spaces.
8	Format the GPS data as a date in the format DD/MM/YY This format type should be used for fields containing a 6 digit data such as Field 02, "UTC Data of Position Fix" The command syntax is CC01FnnM8[A1], where the optional A1 parameter causes the year to be displayed as 20yy. For example use the command CC01F02M8 to copy the GPS date to Graphic Field 01

4.8.1.15.4 GPS INTERFACE SETUP COMMANDS

The GPS data setup commands control the operation of the GPS data capture function. By default, the GPS port is set to 4800 baud and the GPS data capture is not enabled.

To enable capture of data, use the CSE command. If the GPS is not set for 4800 baud, then use the CBSnnnn command to set a new baud rate, for example CBS19200 to set the baud rate to 19200.

Table 21: GPS Interface Setup Command

Command	Description
CSE	Enable the following functions: - capturing of GPS data - copying of data from GPS fields to Graphic Fields - graphic overlay updates on new data or timer
CSD	Disable the following functions - capturing of GPS data - copying of data from GPS fields to Graphic Fields - graphic overlay updates on new data or timer
CSDE	Enable capturing of GPS data.
CSDD	Disable capture of GPS data
CSGE	Enable copying of data from GPS field to Graphic Fields
CSGD	Disable copying of data from GPS fields to Graphic fields
CSUE	Enable Graphic Overlay updates on new data received
CSUD	Disable Graphic Overlay updates on new data received. New data will not display unless an overlay update command is issued to the control port.
CSCE	Enable the DX-2200 to clear text from Graphic Fields that are configured to receive GPS data. When the configuration of the DX-2200 is saved, the current text data will also be saved. This command clears the text on startup so that old data is not displayed on the overlay.
CSCD	Disable clearing of text fields on startup.
CSRE	Enable update of Graphic Fields (and draw overlay if so enabled) when GPS data is received that is identical to the previous data. Graphic update performance may be reduced when this mode is enabled.

Command	Description
CSRD	Disable updating graphic fields when GPS data is identical to previous data.
CSKE	Ignore checksum errors on the GPS data. By default sentences with checksum errors are discarded.
CSKD	Verify the checksums on GPS sentences and discard those with bad checksums.
CSTn	Set the update timer in tenths of a second. The update timer causes text to be copied from GPS fields to Graphic Fields at an interval even when no data is received from the GPS. A value of zero disables the timer updates. Parameter n has a range of 0 to 100000 tenths of a second.
CSLn	Set the overlay Layer that GPS data is written to. By default Layer 1 (the top layer in the mix) is used. The valid values for n are 1, 2, and 3. Note that if the layer is changed, the Graphic Field commands to display fields on the overlay must be changed accordingly.
CSU	Copy data from GPS fields to Graphic Fields now (for all fields defined by CC commands).
CSC	Clear all GPS data fields now.
CBSnnnnn	Set the baud rate of the GPS port where nnnnnn is the new baud rate. Baud rates from 300 baud to 1000000 are accepted. The default is 4800 baud.
CDn	Specify GPS type. The only supported device type is 1.
CRnnn	Report the contents of GPS field nnn by echoing the string on the control port.
CFPnn"msg"	Enable a prefix message for Graphic Field nn text when copying from GPS fields to the Graphic Fields. A maximum of 31 characters are allowed.
CFSnn"msg"	Enable a suffix message for Graphic field nn text when copying from GPS fields to Graphic Fields a maximum of 31 characters are allowed.
CTA"msg"	Transmit a message to the GPS, appending the asterisk, checksum, and carriage return / linefeed. For example CTA"$PGRMO,PGRMC,1"
CTB"msg"	Transmit a message to the GPS. Only the characters in msg are transmitted. The checksum, carriage return and line feed must be included in the string. For example CTB"$PGRMO,GPGSV,0*22\r\n"
CSSE	After video starts (at startup or after a mode change) use the GPS time to set the Frame Counter Time Clock.
CSSD	Disable setting the Frame Counter Time Clock from the GPS time at startup and when video mode changes.
CSAE	When setting the Frame Counter Time Clock, also set the time format frame counter.
CSAD	When setting the Frame Counter Time Clock, no not set the time format frame counter.
CSF	Set a time offset. GPS data field 59 contains a copy of the time from field 01 "UTC Time of Position Fix", that has been adjusted by the correction specified in this command. The adjustment can be used to shift the clock for local time. It can also be used to correct for delays between the GPS internal time reference and the GPS transmitting its time output sentence. The DX-2200 does not have an input for the reference pulse that is available from some GPS receivers, and uses the start of the NMEA 0183 sentence containing the time as the reference. The GPS may have up to hundreds of milliseconds of delay in sending output messages. When the GPS is used to set the Frame Counter time clock, or the time formatted frame counter, the adjusted time in GPS data field 59 is used. Therefore any clock adjustment set with this command also applies to those displays. The default argument of the CSF command is specified in milliseconds, for example

Command	Description
	CSF-400 to adjust the time in GPS field 59 by -400 milliseconds
	The CFS command also accepts arguments followed by S, M, and H to set adjustments in units or seconds, minutes, or hours. Decimal points are not permitted, but offsets in hours, minutes, seconds and milliseconds can be combined in the command. Each adjustment can have a sign '+' or '-'. If no sign is provided the adjustment is taken as positive, but when the sign is provided, it is sticky and applies to all subsequent arguments until a new sign is found.
	For example:
	• CSF-2h30m – specifies an offset of -2:30:00
	• CSF-2h+30m – specifies an adjustment of -2 hours + 30 minutes for a total adjustment of -1:30:00.
	• CSF2h30m – species an adjustment of +2:30:00
	• CSF5h400 – specifies an adjustment of 5:00:00.4 (five hours and 400 milliseconds).
	The total adjustment allowed has a limit of 24 hours regardless of how it is specified.
	Notes about time adjustment:
	GPS data on the overlay is updated when data is received. If the adjusted time in field 59 is displayed on the overlay, and a correction of for example 400 milliseconds is used with a GPS that updates once per second, the times on the overlay will be displayed as 03:31:20.4, 03:31:21.4, 03:31:22.4, etc. which may not be desirable. If a GPS with a faster update rate and time resolution of 0.1 second were used instead, the output would count as expected.
CSMn	Frame Counter synchronization mode.
	After the frame counter time clock has been set, it runs from a crystal oscillator on the DX-2200 and will gradually drift from real time. Synchronization modes provide a method to keep the time clock synchronized with the GPS.
	n = 0 - no synchronization. The frame counter time clock runs independently.
	n = 1 - monitor GPS time and make micro-adjustments to the frame counter time clock to track the GPS time. If the error is found to exceed the error threshold, the time clock is re-set from the GPS time.
	n = 2 – monitor and GPS time and re-set the time clock when the error exceeds the threshold set by the CSR command.
CSRttt	Set the error threshold in milliseconds for performing a set of the frame counter time clock. The default is 100 milliseconds. The frame counter time clock is compared to the adjusted GPS time in GPS data field 59. If the error in the clock is found to be greater than the threshold, the GPS time is used to set the clock.
CSS	Set the Frame Counter time clock when the next GPS time message is received. The clock is set based on the adjusted time in GPS data field 59
CRP…	Various status reporting commands beginning with CRP are provided for use by the GUI interface. These may also be of use in other applications and are described in Appendix C:

4.8.1.15.4.1 GPS Data Display Example:

The following commands 7 data items at the top of the overlay and are intended for use with 720p video and the Garmin GPS18xLVC receiver. To provide the necessary data for this example, the GPS should be configured to output $GPGGA, $GPRMC, and $GPVTG sentences.

```
CSE                    ' enable GPS interface
CSCE                   ' clear text at startup

' Use Graphic Field 01 to display GPS Time
S1X20                  ' graphic field 1 position
S1Y20                  ' graphic field 1 position
S1F28                  ' graphic field 1 font
S1S                    ' graphic field 1 show
CFS01" UTC"            ' graphic field 1 suffix "UTC"
CC01F01M3              ' store GPS time

' Use Graphic Field 02 to display GPS date
S2X20                  ' graphic field 2 position
S2Y60                  ' graphic field 2 position
S2F28                  ' graphic field 2 font
S2S                    ' graphic field 2 show
CC02F02M8A1            ' store GPS date

' Use Graphic Field 03 to display GPS Latitude
S3X300                 ' graphic field 3 position
S3Y20                  ' graphic field 3 position
S3F28                  ' graphic field 3 font
S3S                    ' graphic field 3 show
CC03F03M6A04           ' store GPS latitude

' Use Graphic Field 04 to display GPS Longitude
S4X300                 ' graphic field 4 position
S4Y60                  ' graphic field 4 position
S4F28                  ' graphic field 4 font
S4S                    ' graphic field 4 show
CC04F05M6A06C0         ' store GPS longitude

' Use Graphic Field 05 to display true course over ground
S5X650                 ' graphic field 5 position
S5Y20                  ' graphic field 5 position
S5F28                  ' graphic field 5 font
S5S                    ' graphic field 5 show
CFP05"Course "         ' prefix text
CC05F09M7              ' store GPS course over ground

' Use Graphic Field 06 to display speed over ground
S6X650                 ' graphic field 6 position
S6Y60                  ' graphic field 6 position
S6F28                  ' graphic field 6 font
```
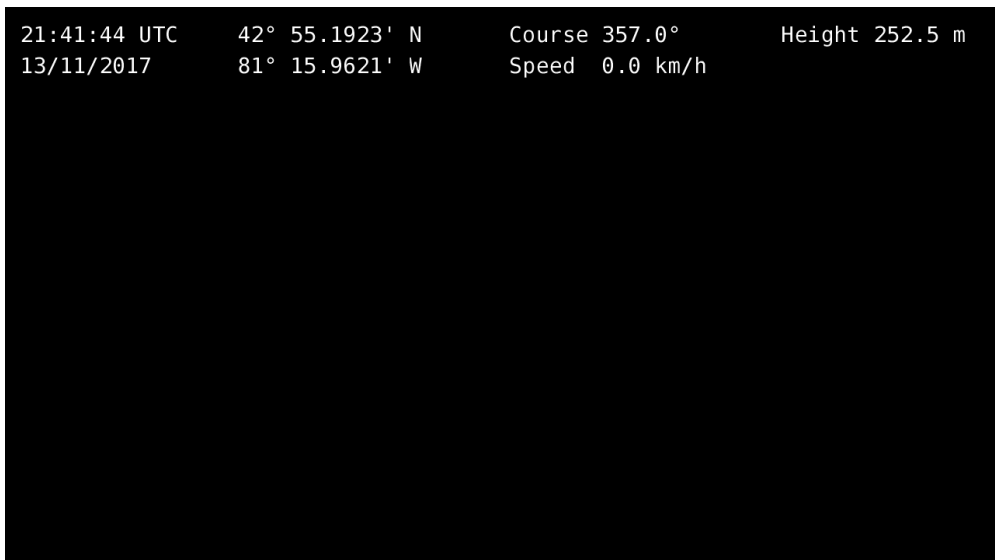
```
S6S                             ' graphic field 6 show
CFP06"Speed  "                  ' prefix text
CFS06" km/h"                    ' suffix text
CC06F08M2                       ' store GPS course over ground


' Use Graphic Field 07 to display height
S7X1000                         ' graphic field 7 position
S7Y20                           ' graphic field 7 position
S7F28                           ' graphic field 7 font
S7S                             ' graphic field 7 show
CFP07"Height "                  ' prefix text
CFS07" m"                       ' suffix text
CC07F11M1                       ' store GPS course over ground
```

```
21:41:44 UTC      42° 55.1923' N      Course 357.0°      Height 252.5 m
13/11/2017        81° 15.9621' W      Speed  0.0 km/h
```

Figure 24: Example of GPS Data Display

4.8.1.15.4.2 Example with the Frame Counter Time Clock set by the GPS:

In this example the GPS interface is enabled and used to set the time clock in the Frame Counter. The frame counter is displayed in the top left corner of the screen. Mode 7 is selected to show the time clock display mode with 2 decimal places. Refer to the Frame Counter commands for more information.

```
CSE                   ' enable GPS interface
CSM1                  ' adjust Frame Counter timeclock to stay in sync with GPS


SF1X20               ' set frame counter x position
SF1Y20               ' set frame counter y position
SFM7                 ' display frame counter in time clock mode, 2 decimals places
```
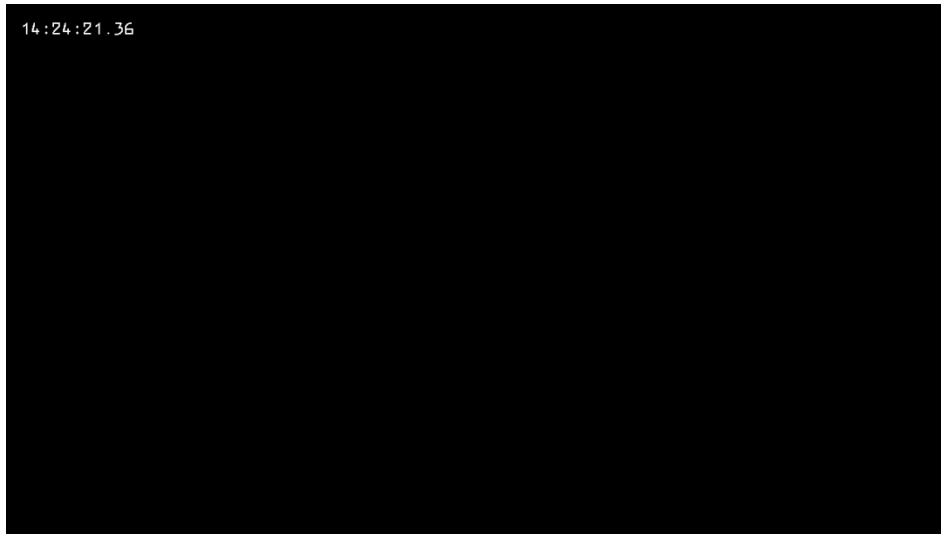
Figure 25: Example of Frame Counter Time Clock Set by the GPS

4.8.1.16 Configuration Flash Serial Commands

The DX-2200-TI uses Flash memory to retain user configuration information. The Flash is configured using the commands shown in Table 22 below.

To save the current configuration, use the 'FW' command. This command saves the current operating settings of the DX-2200 including the default resolution, and graphic field settings. The unit will restart with the saved settings each time it powers up.

NOTES:

1) It is not necessary to erase the Flash before storing a new configuration. A write will automatically erase the old configuration.

2) A saved configuration is only valid for the DX-2200 firmware version that saved it. If the DX-2200 firmware is updated, the saved configuration will be lost.

3) Baud rate cannot be saved in the configuration. The DX-2200 always starts at 115200 baud.

Table 22: Flash Serial Command Codes

Command Code	Mode of Operation
Flash Write/Erase/Reset Commands	
FW	Write the current configuration to the flash memory. The saved configuration will be loaded whenever the DX-2200 starts.
FE	Erase the saved configuration from flash. The DX-2200 will use default configuration after the next restart.
FR	Erase the saved configuration flash and reset the DX-2200 in default factory configuration. Note that the FR command does not erase any images that have been uploaded to the DX-2200.
FIC	Clear the uploaded images from memory. This command clears only the copy of images stored in main memory. It does not erase images stored in the flash. To erase the flash memory, first execute FIC and then FIW.
FIW	Write the image memory to flash. This command may take a few minutes to complete.

4.8.1.17 Other Serial Command Codes

Other miscellaneous Serial Command codes are listed in Table 23 below and discussed in the following sections.

4.8.1.17.1 SERIAL PORT RESET SERIAL COMMAND

Sending a Carriage Return or a Linefeed (CR or LF) ASCII code resets or clears the Serial Command buffer on the DX-2200-TI.

Table 23: Other Serial Command Codes

Command Code	Mode of Operation
	IP Core Revision Code
RV	Polls the board for the product ID and IP Core revision
RSn	Report the input video resolution at input n where n = 1 for input 1 and n=2 for input 2. When these commands are received, the DX-2200 outputs a response message in the format X<LF>+, where X is one of the following values: X = 0: No video or unsupported mode X = 1: 720p X = 2: 1080p X = 3: 1080i X = 4: NTSC X = 5: PAL When this command reports a video resolution, it only indicates that the input video is recognized by the DX-2200. It does not mean the input is compatible with the current operating mode of the product, or that it is available for display. See also the RIn commands.
RIn	Report input video resolution at input n where n = 1 for input 1 and n=2 for input 2. When these commands are received, the DX-2200 outputs a response message in the format X<LF>+, where X is one of the following values: X = 0: No video or unsupported mode X = 1: 720p X = 2: 1080p X = 3: 1080i X = 4: NTSC X = 5: PAL The RI commands will return X=0 when the input video mode is not supported by the product, or when the video is not valid for the current configuration. For example if input 1 is 1080p video, and input 2 is 1080i, the RI2 command returns return X=0. Even though 1080i is supported by the DX-2200, it cannot be used as a PiP overlay when input 1 is a progressive video format. In this case, the return value of 0 indicates the video cannot be displayed.
RO	Report the current video ouput resolution. The DX-2200 outputs a response message in the format X<LF>+, where X is one of the following values: X = 0: No video X = 1: 720p

	X = 2: 1080p X = 3: 1080i X = 4: NTSC X = 5: PAL
FS	Restart (reset) the DX-2200-TI
RP…	A set of status reporting commands beginning with RP are provided for use by the GUI interface. These may also be of use in other applications and are described in Appendix C:

4.8.2 MANUAL Mode of Operation

In the MANUAL mode, the operation of the DX-2200-TI is controlled by the momentary bi-directional Toggle Switch and the DIP switches as described in Table 24 and Table 25 below. SERIAL Control is still available when MANUAL mode has been enabled.

When MANUAL mode is enabled, some settings can be controlled by both the DIP switch and SERIAL commands. In the case where a SERIAL command is used to change a setting that is also controlled from the DIP switch, the setting of the switch will be overridden. Changing the position of the switch will return control of the setting to the DIP switch.

The functions of the DIP and Toggle Switch are programmable by Serial Commands. The following section describes the factory default configuration.

4.8.2.1 Toggle Switch

In the factory default configuration, the 2-position momentary Toggle Switch (labeled SW2) is used to switch input and to select the operating mode from a variety enhanced video processing functions described in Table 24 below.

Table 24: Operation of 2-Position Momentary Toggle Switch

Switch Movement	Mode of Operation
Toggle Left (TL)	Toggle Graphics Layer 1 On / Off. This switch executes the L1T command to toggle the visibility of the text layer.
Toggle Right (TR)	Toggle the Graphics Layers 2 and 3 On / Off. This switch executes the L2T and L3T commands to toggle the visibility of both layers.

4.8.2.2 Bypass Saved Configuration Using Toggle Switch

The DX-2200 normally loads the saved configuration at power up. If the saved configuration is corrupted then it is possible the unit will not start. To recover from this situation, disconnect power from the unit, push the Toggle Switch left (towards the power connector), and then re-connect power while continuing to hold the switch for four seconds. The DX-2200 will start with the defaults instead of loading the saved configuration.

Note that the saved configuration is not erased by this procedure and will load again the next time the product is reset or powered up. To permanently clear the configuration, issue the FR command, or use the FW command to write the current configuration to the flash.

4.8.2.3 DIP Switch Settings

For MANUAL mode, the DIP switch settings control the operation of the DX-2200-TI. The factory default settings are summarized below:

Table 25: Operation of the 4-Position DIP Switch

SW4	SW3	SW2	SW1	Output Display Mode
x	x	OFF	OFF	Sets the mode of the DX-2200-TI to Text Inserter without PiP display (equivalent to the M1 Serial Command). In this mode the video on the second input is never displayed.
x	x	OFF	ON	Sets the mode of the DX-2200-TI to Text Inserter with PiP (equivalent to the M2 Serial Command). If there is a compatible signal on the second input, it will be displayed as the PiP.
x	x	ON	OFF	Sets the mode of the DX-2200-TI to Text Inserter with scaling (equivalent to the M3 Serial Command). In this mode the main input can be scaled up. PiP is not displayed and the second input is not used.
x	x	ON	ON	This switch combination does not apply any mode setting to the DX-2200-TI
OFF	OFF	x	x	Set PiP mode position to the upper right corner Set Scaler mode zoom 100% (equivalent Serial Commands P1;ZS100)
OFF	ON	x	x	Set PiP mode position to lower right corner, Set Scaler mode zoom to 125% (equivalent Serial Commands P2;ZS125)
ON	OFF	x	x	Set PiP mode position to upper left corner Set Scaler mode zoom to 150% (equivalent Serial Commands P3;ZS150)
ON	ON	x	x	Set PiP mode position to lower left corner Set Scaler mode zoom to 200% (equivalent Serial Commands P4;ZS200)
By default, the settings of the DIP switch are read when the switch is changed and also at startup if there is no saved configuration. When there is a saved configuration the switch is not read at startup to avoid overriding the saved settings. Refer to the user interface commands for other DIP switch options.				

5 DX2200 Software Upload Utility

The *DX2200 Software Uploader* is a Java application supplied with the DX-2200-TI-03 that can be used to update the product firmware, or to upload graphic images into the product for use as an Overlay.

5.1 Firmware Update Procedure

The firmware update procedure is documented in the **DX-2200 Software Uploader User Manual** available for download from the Document Library in the Support area of our website at:
www.microtronix.com/SUPPORT/downloads.html

Contact *support@microtronix.com* for the latest release of the DX-2200 firmware and Software Uploader utility.

NOTE: DX-2200-TI-03 Text Inserter product running firmware versions less than 1.10 cannot be upgraded over RS232. It is recommended not to downgrade a unit to any version less than 1.10 because it will lose the ability to update over RS232. For units that cannot be updated by RS-232, refer to A.4.1 JTAG Firmware Upload Procedure or contact Microtronix sales about upgrading the unit.

5.2 Uploading Images

The DX-2200-TI-03 can store one or more images in memory. A stored image can be displayed on the Overlay by configuring a Graphic Field to show that image.

A maximum of slightly less than 2 Mega Pixels can be stored in flash memory. The pixels can be used for a single large image, or for many smaller images. For example, one full frame image for 1920x1080 video can be stored, or up to 64 images at 240 by 135 pixels each.

When an image is uploaded, an identification number (ID) is assigned to the image. The ID is used to select that image when it is to be displayed on the overlay. It is recommended to keep a record of the ID number used when images are uploaded.

The DX2200 Software Uploader program can show a list of images that are stored in the memory with their sizes and ID, and also reports how many pixels are available in flash memory. Individual images can be deleted, or the entire memory can be cleared to remove all images.

The DX2200 Uploader software accepts image files in PNG and JPEG format. The PNG file format supports Red, Green, and Blue channels, and also supports an optional transparency channel to set the visibility of each pixel. The JPEG file format support Red, Green and Blue channels. The DX-2200-TI-03 accepts files with or without the transparency channel. When a file without transparency is uploaded, all pixels are visible. When the file includes a transparency channel, different parts of the image can have different visibility for example to generate smooth edges, or to overlay images that are not rectangular.

WARNING: Most PNG files do not include a transparency channel. To generate a PNG file with transparency an image editor such as Adobe Photoshop or Gimp can be used.

NOTE: The capability to store images permanently in flash memory requires a unit with 16 MB of serial flash memory. These units are identified with PN: DX-2200-TI-03. Units shipped prior to April 2014 (PN: DX-2200-TI-02) do not have the required flash memory and cannot permanently store images. Images can still be uploaded to the unit, but are lost on reset or power-off.

6   Text Writing Performance Measurements

The text writing speed of the DX-2200-TI has been benchmarked at 1080p30 and 720p60 video resolutions using a program on a PC to deliver text strings and commands to the SD/HD-SDI Text & Graphics Inserter unit. The PC program uses Standard Graphic Overlay Control Commands (per commands of Table 13) and also Low Level Overlay Control Commands (per commands of Table 14).

With the standard Graphic Overlay Commands, all of the video text is rendered (i.e. generated in the active display buffer) when Fields are changed. However, with the Low Level Overlay Commands, the user program first renders the static (i.e. non-changing) text to both the active and spare buffer and then updates only the changing text string into the spare (background) buffer and then simply swaps the buffers (upon the user Serial Command). To maximize the speed of text updates, text in the new background buffer is not cleared after the swap and only changing Text Fields are rendered in the background buffer. The results of the two methods are provided in the following sections.

6.1   Standard Text String Update Benchmark Measurements

In this test a number of characters were written through the Serial Port of the DX-2200-TI for OSD using three font sizes: the F001 (small 26 pixel height), F002 (medium 40 pixel height) and F003 (large 78 pixel height). A total of 20 of the characters were subsequently changed for each update. The time required to update the output display was measured in frames of delay. The results are summarized below.

Table 26: Update Rate for Standard Text String Commands

Font	Video	# of Characters		Frames to Update Output
		Written	Changing	
F001	720p60	147	20	13
F001	720p60	294	20	20
F001	720p60	588	20	33
F001	1080p30	323	20	15
F001	1080p30	664	20	22
F001	1080p30	1328	20	37
F002	720p60	64	20	13
F002	720p60	128	20	19
F002	720p60	256	20	31
F002	1080p30	18	20	13
F002	1080p30	288	20	22
F002	1080p30	576	20	36
F003	720p60	18	20	13
F003	720p60	36	20	19
F003	720p60	72	20	32
F003	1080p30	40	20	14
F003	1080p30	80	20	22
F003	1080p30	120	20	23

6.2   Low Level Text String Update Benchmark Measurements

The Low Level String update first renders the static text to both buffers. Next it updates the changing text field in the back buffer and then switches buffers without clearing the non-changing text. This results in a lower frame delay in the display of text. The results are summarized below.

Table 27: Update Rate for Low Level String Commands

Font	Video	# of Characters		Frames to Update Output
		Written	Changing	
F001	720p60	20	20	2
F001	1080p30	20	20	1
F002	720p60	20	20	3
F002	1080p30	20	20	2
F003	720p60	20	20	7
F003	1080p30	20	20	4

7 Extended Fonts Tables

7.1 Wingdings Fonts

The wingdings fonts have been selected from the three wingdings tables and the webding table.

Table 28: Windings Character Table

Symbol	Char	Hex Value	Symbol	Char	Hex Value	Symbol	Char	Hex Value
⌛	space	0020	↻	7	0037	⏪	L	004C
💾	!	0021	↺	8	0038	⏩	M	004D
☮	"	0022	←	9	0039	⏮	N	004E
✋	#	0023	→	:	003A	⏭	O	004F
☺	$	0024	↑	;	003B	⏸	P	0050
☹	%	0025	↓	<	003C	■	Q	0051
☠	&	0026	↖	=	003D	●	R	0052
✈	'	0027	↗	>	003E	⚒	S	0053
☸	(	0028	↙	?	003F	✔	T	0054
●	)	0029	↔	@	0040	🚑	U	0055
■	*	002A	↕	A	0041	ⓘ	V	0056
☝	+	002B	▲	B	0042	✈	W	0057
☞	,	002C	▼	C	0043	🚀	X	0058
⊘	-	002D	△	D	0044	✦	Y	0059
⇇	.	002E	▽	E	0045	●	Z	005A
⇉	/	002F	◀	F	0046	♺	[	005B
⇈	0	0030	▶	G	0047	⊘	\	005C
⇊	1	0031	◁	H	0048	⊖	]	005D
↩	2	0032	▷	J	004A	✗	^	005E
↺	3	0033	◂	K	004B	↘	_	005F
↴	4	0034	▸	H	0048			
↩	5	0035	▴	7	0037			
↻	6	0036	▾	8	0038			

7.2 Extended ASCII Fonts

Table 29: Extended ASCII Character Table

Symbol	Hex Value	Symbol	Hex Value	Symbol	Hex Value	Symbol	Hex Value
	00A0	¸	00B8	Ð	00D0	è	00E8
¡	00A1	¹	00B9	Ñ	00D1	é	00E9
¢	00A2	º	00BA	Ò	00D2	ê	00EA
£	00A3	»	00BB	Ó	00D3	ë	00EB
¤	00A4	¼	00BC	Ô	00D4	ì	00EC
¥	00A5	½	00BD	Õ	00D5	í	00ED
¦	00A6	¾	00BE	Ö	00D6	î	00EE
§	00A7	¿	00BF	×	00D7	ï	00EF
¨	00A8	À	00C0	Ø	00D8	ð	00F0
©	00A9	Á	00C1	Ù	00D9	ñ	00F1
ª	00AA	Â	00C2	Ú	00DA	ò	00F2
«	00AB	Ã	00C3	Û	00DB	ó	00F3
¬	00AC	Ä	00C4	Ü	00DC	ô	00F4
-	00AD	Å	00C5	Ý	00DD	õ	00F5
®	00AE	Æ	00C6	Þ	00DE	ö	00F6
¯	00AF	Ç	00C7	ß	00DF	÷	00F7
°	00B0	È	00C8	à	00E0	ø	00F8
±	00B1	É	00C9	á	00E1	ù	00F9
²	00B2	Ê	00CA	â	00E2	ú	00FA
³	00B3	Ë	00CB	ã	00E3	û	00FB
´	00B4	Ì	00CC	ä	00E4	ü	00FC
µ	00B5	Í	00CD	å	00E5	ý	00FD
¶	00B6	Î	00CE	æ	00E6	þ	00FE
·	00B7	Ï	00CF	ç	00E7	ÿ	00FF

8   Product Warranty

8.1   Hardware Warranty

Microtronix warrants Product hardware to the original purchaser to be free from defects in material or workmanship under normal use for **one (1) year** from the date of purchase, when used within the operating limits set forth in this Product User Guide. Microtronix agrees under this warranty, to repair or replace it with a new or reconditioned product at no additional charge. Replacement products are warranted for the balance of the original warranty time period.

If the Product proves defective during the warranty period, call Microtronix Technical Support in order to obtain a Return Materials Authorization number. Microtronix will provide **Cross Shipment Support** for warranty replacement of defective units during the warranty period. Customers shall be held responsible for shipping and handling charges incurred in returning the product to Microtronix. Microtronix (as opposed the customer) will cover the cost of shipment of the replacement Product provided a warranty defect has occurred.

Our hardware warranty does not cover any Product, which has been subject to neglect, unreasonable use, accident, and violation of operating instruction or any product that has been repaired or modified by an unauthorized service agent.

8.2   Firmware Warranty

Microtronix warrants that commencing from the date of delivery to the Customer for a period of one (1) year the Product Firmware (Software) will substantially conform to its published specifications. The Customer's sole and exclusive remedy and the entire liability of Microtronix under this limited warranty will be, at Microtronix's option; firmware replacement, or firmware upgrade repair. In no event does Microtronix warrant that the Software is error free or that the Customer will be able to operate the Software without problems or interruptions.

8.2.1   Limited Liability

Microtronix Products are not designed or approved by Microtronix for use in **safety-critical** or **life-critical system** or application in which a failure or malfunction may result in one (or more) of the following outcomes: (a) death or serious injury to people, (b) loss or severe damage to equipment/property, of (c) environmental harm. Microtronix assumes **no liability** for any consequential damages – whether direct or indirect – if the product is used in this type of application.

IN NO EVENT SHALL MICROTRONIX'S LIABILITY EXCEED THE PRICE PAID FOR THE PRODUCT FROM DIRECT, INDIRECT, SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES RESULTING FROM THE USE OF THE PRODUCT, ITS SOFTWARE, OR ITS DOCUMENTATION.

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Appendix A: Internal Circuit Board Description

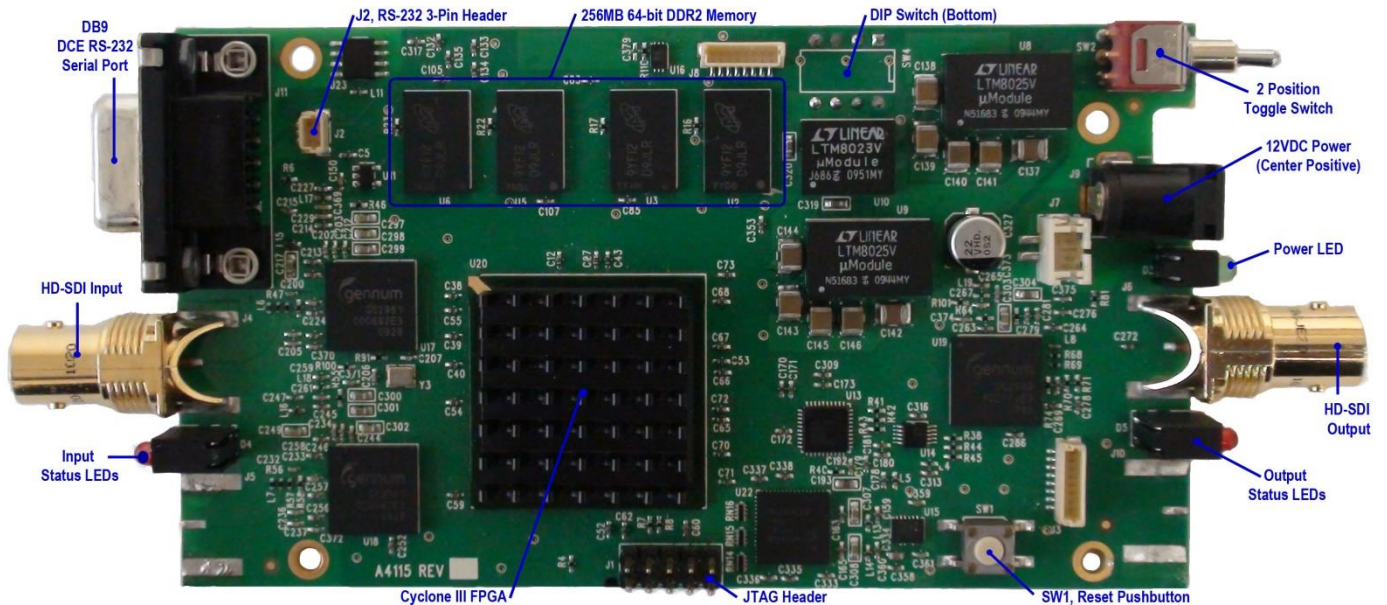The DX-2200-TI – HD-SDI Text & Graphic Inserter Board is shown in the following figure.

Figure 26: DX-2200-TI – HD-SDI Text & Graphics Inserter Board

The **DX-2200-TI – HD-SDI Text & Graphic Inserter Board** is utilizes the following hardware devices:

- Cyclone EP3C120F780C7N FPGA
- SDRAM Memory: 256 MB (64-bit interface), 4 x Micro MT47H32M16BN-3, 32Mx16b DDR2
- Gennum GS2962 3G/HD/SD-SDI Serializer (Transmitter) with Cable Driver
- Gennum GS2962 3G/HD/SD-SDI Deserializer (Receiver) with Equalizer
- Gennum GS4911B HD/SD/Graphics Clock and Timing Generator
-

The following sections describe the hardware used in each of the two product configurations.

A.1 SDI Video Interfaces

The **DX-2200-TI** supports one SD/HD-SDI input and one SD/HD-SDI output port. These interfaces support SMTP 292M video formats. The SDI output is reclocked from a Gennum Timing Generator which runs asynchronously to the video inputs.

A.2 RS-232 Serial Control Port

The RS-232 Serial Control Port is used to control the text overlay. It is a DB9 female connector. The Control Port transmit and receive data is on the standard pin numbers 2 & 3, and the port is set at 115,200 baud operation (8N1). There is no hardware flow control for the Control Port.

For units with board revision D and above, the connector is customized with a second port on pins 7 & 8. The second port is used for the GPS data receiver function and other customized product variations. The baud rate of the second port depends on the application.

Both receivers accept standard RS232 levels and can also accept 5V logic signaling. For 5v logic signaling, the low level must be less than 0.6V and the high level must be greater than 1.5V. The transmitter output levels are typically +5.5V and -5.5V into a 3 kΩ load.

An optional splitter cable is available that connects to the DB9 connector and provides both ports on separate DB9 sockets with transmit data on pin 2 and receive data on pin 3.

The pin assignments of the DB9 connector on the DX-2200 are provided in the following table.

Table 30: RS-232 Serial Port DB9 Pin Assignments

Pin	Signal Direction	Function	Signal Name
2	DX-2200 Output	Control Port	Transmit Data
3	DX-2200 Input	Control Port	Receive Data
5	-	-	Signal Ground
7	DX-2200 Input	GPS Port	Receive Data
8	DX-2200 Output	GPS Port	Transmit Data

A.2.1 RS-232 3-Pin Header, J2

The RS-232 Serial Control Port is also available on J2, a 3-pin 1mm header (JST part number: BM03B-SRSS-TB(LF)(SN) available from Digi-Key 455-1789-1-ND).   The pins assignments are listed in the following table.

Table 31: RS-232 3-Pin Header, J2

Pin	Signal Direction	Signal Name
1	Input	Receive Data
2	-	Signal Ground
3	Output	Transmit Data

A.3 Power Requirements

The board is powered from a standard 5.5mm center positive 5-12Vdc 10W (120/240VAC) regulated power adapter. The unit draws a maximum of 650mA at 12VDC.

A.3.1 Power Connectors

The power connector J9 is standard 2.5mm diameter by 5.5mm long jack PN: CUI PJ-202BH (Digi-Key CP-202BH-ND).

For embedded applications requiring a board-to-board wire harness connection, header J7, PN: JST B2B-PH-SM4-TB(LF)(SN)(P) (Digi-Key 455-1734-1-ND) can also be used for the power connection.

A.4 JTAG Header

The JTAG header is used to program the configuration flash device used load the FPGA device on power up with the DX-2200 program file. This method is designed for OEM's who have purchased the DX-2200

product as an open-frame board. The procedure required the user to load a JIC file into the on-board serial flash configuration device through the JTAG Interface. This requires the use of suitably configured PC with an Altera or Terasic USB Byte Blaster (available for optional purchase) connected to the JTAG connector (J1) as shown in the following figure.
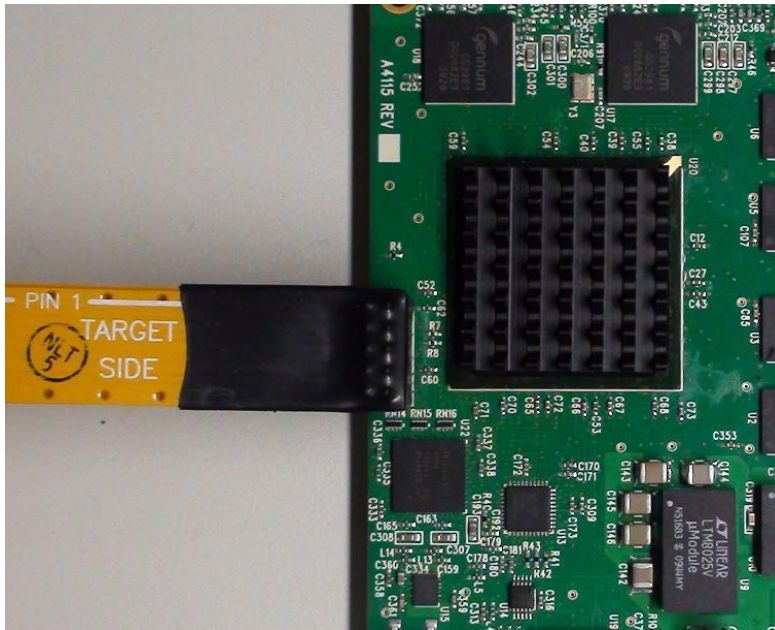
Figure 27: JTAG Cable Connection

A.4.1 JTAG Firmware Upload Procedure

The steps to upgrade the firmware using the JTAG port are as follows:

1) Start Quartus II on the PC. Note that Quartus must be version 12.1 or later to load the JIC programming files for the DX-2200-TI.
2) From the **Tools** menu, select **Programmer**.
3) Click Auto Detect.
4) A dialog box may appear with a selection for EP3C120 or EP4CE115. Select **EP3C120**, click **Close**.
5) Select the line in the programmer window containing the EP3C120 device.
6) Click **Change File…** and browse to the .jic file to load. Select it and click **Open**.
7) Check the Program/Configure box.
8) Click **Start** to program the FPGA.

A.5 Reset Pushbutton SW1

The Reset pushbutton (SW1) is not available if the unit is in the enclosure. It is used to reset the FPGA and restart the switcher.

A.6 Board Mechanical Dimensions

The board mechanical dimensions are shown in Figure 28 below.

Figure 28: DX-2200 Board (PN: P4115-TI-24) Mechanical Drawing

Appendix B: USB to RS-232 Serial Port Adapter

The **USB to DB9 RS-232 Serial Port Adapter Kit** (PN: 811-USB-RS232 Kit) is used to connect the DB9F Serial Port to a USB port of a PC. The Kit consists of a USB 2.0 to RS232 DB9 Serial Adapter Cable (StarTech PN: ICUSB232V2) and a 6 foot male to female DB9 RS232 serial cable as shown in the figure below.
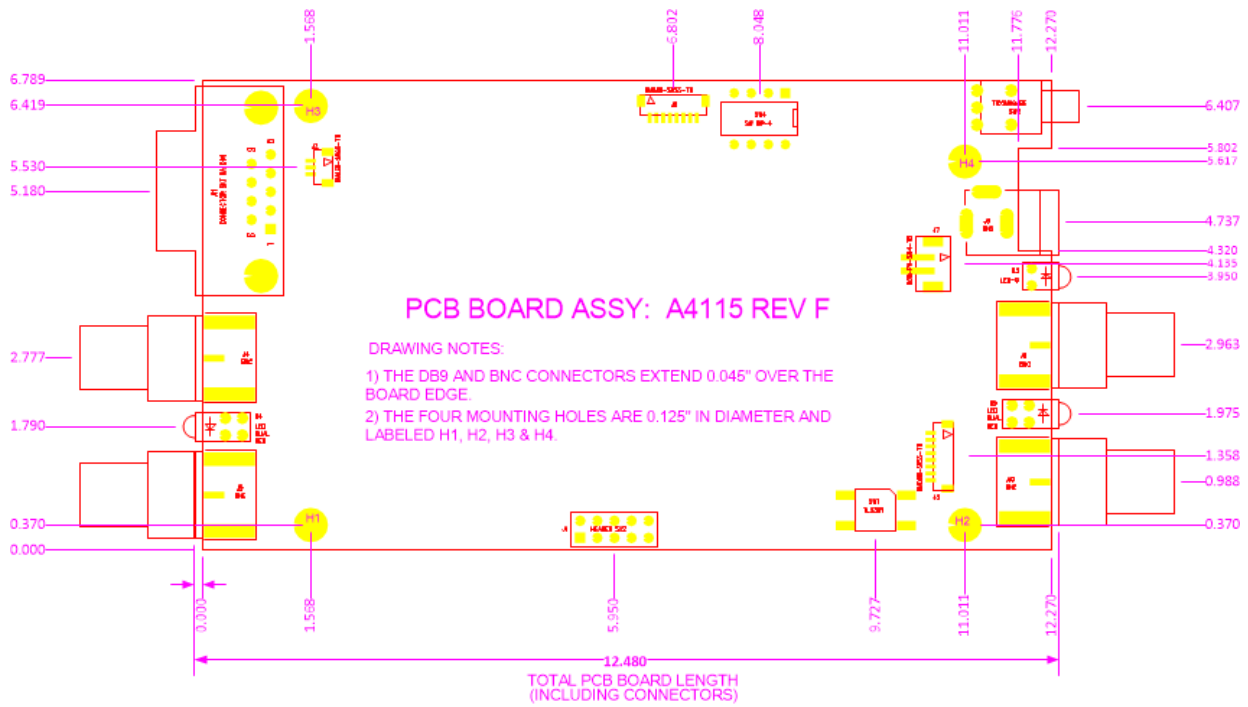

Figure 29: USB to DB9 RS-232 Serial Port Adapter Kit

B.1 ICUSB232V2 Software Drivers

The StarTech ICUSB232V2 adapter is used to convert the RS232 serial interface to a USB 2.0 interface when connecting to a PC which does not have a DB9M RS232 serial port (i.e. most PCs today). The software drivers for the ICUBS232V2 adapter are supplied by StarTech and are available for free download from www.startech.com/downloads.

Connect to the website using a browser and search for the product using product ID (ICUSB232V2) and click Search. Select the product from the search results and download the available Prolific_PL23203.zip file. Once downloaded right-click the zip file and extract the contents to a temp directory. Browse to the directory of the relevant OS and read the supplied text and pdf files on how to install and use the USB to RS232 serial adapter.

B.1.1 Installation of ICUSB232V2 Serial Driver and Terminal Emulator Program

1) Follow the instructions supplied with the StarTech PN: ICUSB232V2 – USB – RS-232 Serial Adapter.

2) Once the driver is installed, attach the USB Serial adapter to a USB port.

3) To identify the serial COM port the operating system has assigned to the port:

    a. Use the "WINDOWS Key + X" to bring up the device manager.

    b. Under Ports note the port number assigned to the "Prolific USB-to-Serial Comm Port. For example, COMx when x is from 1 to 14.

Note: StarTech has also supplied a program called checkChipVersion_v1006.exe which can also be used to identify the serial port.

Caution: If the USB Serial Adapter is moved to a different port on the PC, the OS will assign it a new COM port number requiring a change to the Terminal Emulation port assignment.

4) Download and install a Terminal Emulator program to facilitate serial communion of user commands to the DX-2200. For example PuTTY. (Available from: https://www.chiark.greenend.org.uk/)

B.2 Establishing Serial Communications

1) Run the PuTTY program.

TIP: It is convenient to place a shortcut link on the desktop to the PuTTY software application.

2) Configure PuTTY as follows:

    a. Select the Session item:

        i. For Serial line >> enter the assigned Port i.e. COM3

        ii. Set Speed to 115200.

        iii. For Connection type: >> select Serial

        iv. Under Saved Session: Assign a name to this user setting. i.e. DX-2200 Serial

        v. Save the configuration.

    b. Select the Terminal item.

        i. Additionally check the boxes for:

            1. Implicit CR in every LF and for

            2. Implicit LF in every CR.

    c. Select the Serial item.

        i. Set the Serial line to the required come port i.e. COM3

        ii. Set the Speed to: 115200, Data bits to: 8, Stop bit to: 1, Parity to: None, and Flow Control to: None.

    d. Select the Session item again and re-save the configuration to DX-2200 Serial. **NOTE:** Going forward when restarting PuTTY, it is only necessary to select the DX-2200 Serial configuration and "Load" it from disk.

    e. Connect the USB Adapter to the DB9 serial cable and attach the male DB9 connector to the serial port of the DX-2200 unit.

    f. In the Session section,

        i. Confirm the DX-2200 Serial configuration is selected and then click Load.

        ii. Click "Open" to a Terminal connection to the unit.

        iii. Type the "ENTER" to get an * response from the unit.

        iv. Type **rv** to display the version of the software used by the DX-2200 product.

This confirms serial communication with the DX-2200 product. The figures below show some of the PuTTY configuration screens.
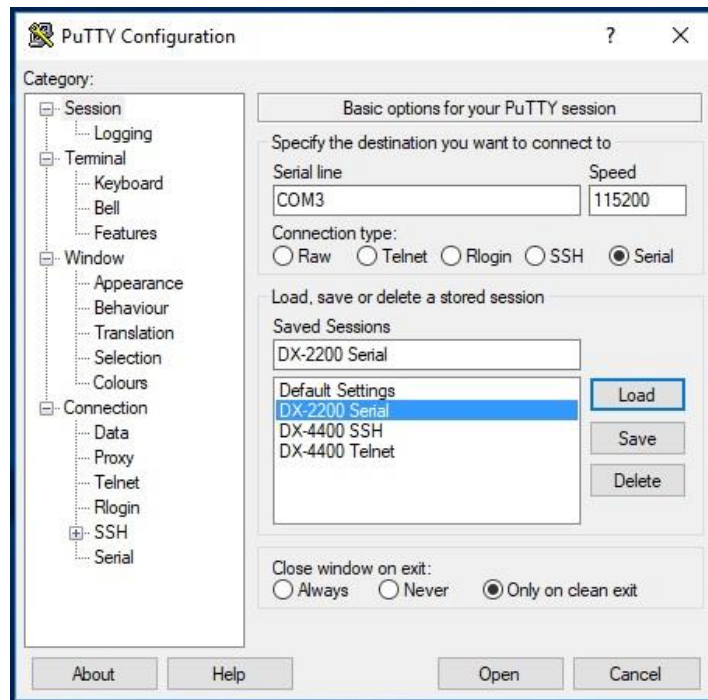
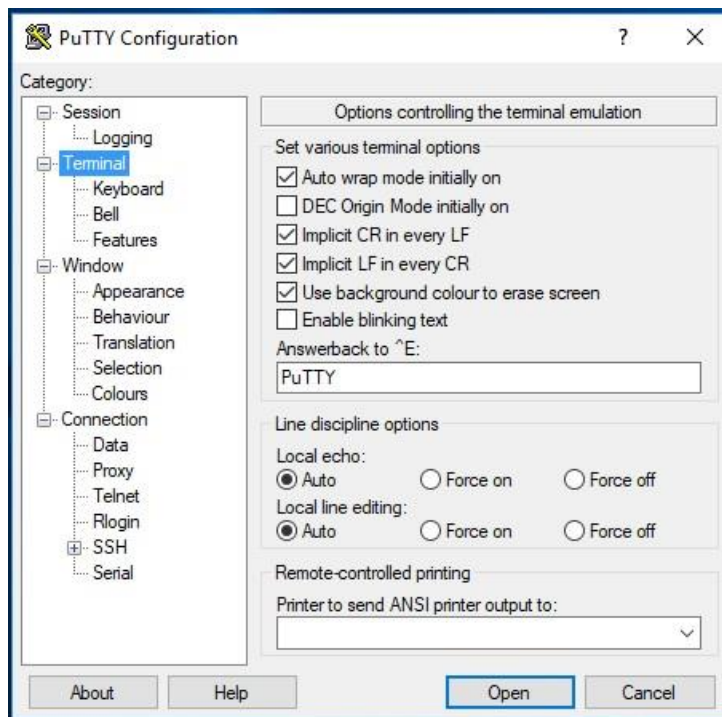**Figure 30: PuTTY Session User Settings**

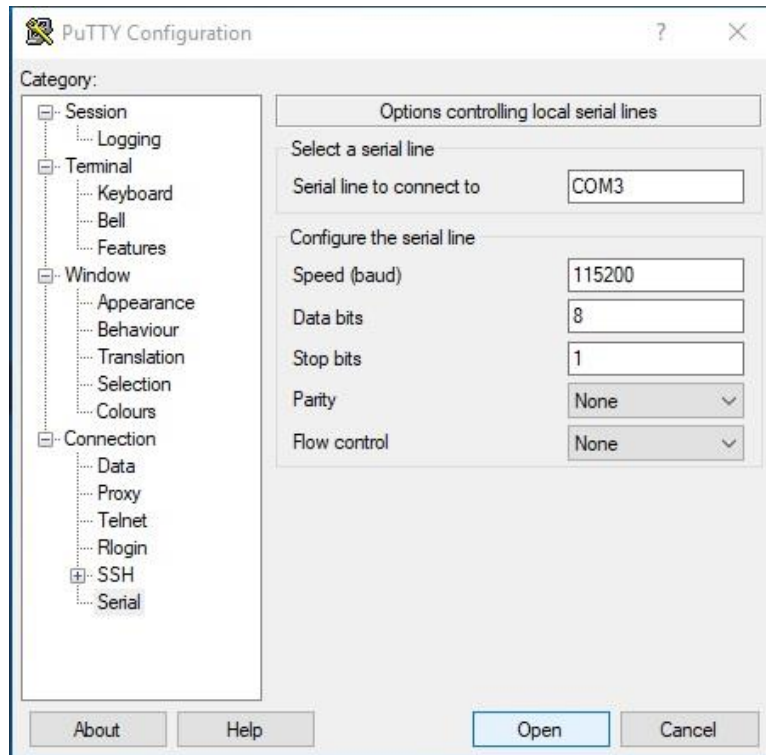**Figure 31: PuTTY Terminal Settings**

Figure 32: PuTTY Serial Port Settings

Appendix C: Reporting Commands

The DX-2200 supports a set of status reporting commands that are primarily intended for use by the GUI interface. These commands may also be useful for manual and computer controlled applications of the unit. The reporting commands are described in this section. The user should expect to spend some time experimenting with the commands to understand how the parameters relate to the setup commands and their meanings in different modes of operation of the product and for different graphic field types.

The reporting commands return a list of fields separated by line feed characters. There is no line feed before the first field, but there is a line feed after the last field. Following the parameter fields, the command returns the usual '+' response if it was successful. Some of the reporting commands accept parameters that affect what fields are returned.

C.1.1 RPF – Report Graphic Field(s)

This command returns the parameters of a graphic field, or all graphic fields on a layer. The command requires two parameters and the usage is as follows:

RPFa,b

where:

a is the layer number and is between 1 and 3 for the DX-2200 Text Inserter.

b is the graphic field number from 1 to 48, or is 0 which will list all 48 fields.

Table 32: RPF Command Output

Field	Description
RPF – Command Output (for a single field)	
n	Graphic field type 1..6
v	Visible 0..1
font	The font number. A value of 0 indicates the default font that changes based on video size
X0	Primary x position
Y0	Primary y position
X1	Secondary x position used for certain field types, for example rectangles
Y1	Secondary y position used for certain field types, for example rectangles
Alpha	Alpha value for Text / Line 0..255
Red	Red value for the Text / Line color 0..255
Green	Green value for the Text / Line color 0..255
Blue	Blue value for the Text / Line color 0..255
Fill Alpha	Fill / Background Alpha 0..255
Fill Red	Fill / Background Red color value 0..255
Fill Green	Fill / Background Green color value 0..255
Fill Blue	Fill / Background Blue color value 0..255
Vertical Width	Width of vertical lines, applicable to some field types
Horizontal Width	Width of horizontal lines, applicable to some field types

Width Left	Width of the left line, applicable to rectangles
Width Right	Width of the right line, applicable to rectangles
Width Top	Width of the top line, applicable to rectangles
Width Bottom	Width of the bottom line, applicable to rectangles
Vertical Length	Length in the y direction for specific field including target and corner marker
Horizontal Length	Length in the x direction for specific field including target and corner marker
Fill Width Left	Fill width from the left edge of a rectangle
Fill Width Right	Fill width from the right edge of a rectangle
Fill Width Top	Fill width from the top edge of a rectangle
Fill Width Bottom	Fill width from the bottom edge of a rectangle
Justify	Text justification width
Justify Mode	Text justification mode
Image	The image number to display when the field is used as an image field
Feature	The bits of this parameter represent certain field type specific functions that are controlled with the GnnKfs command
Fill Enable	Indcates if rectangle filling is enabled 0..1
"Text"	Text string, returned inside quotation marks

C.1.2 RPM – Report Mode Parameters

This command returns mode of operation parameters. The command usage is as follows:

> RPM

Table 33: RPM Command Output

Field	Description
RPM – Command Output	
Mode	Operating mode 1..3
Ancillary Data Enable	Ancillary data pass through status. 1 = pass through enabled.
Baud	Baud rate of the serial command port

C.1.3 RPO – Report Output Video Mode Parameters

This command returns the parameters that control the output video mode. The command usage is as follows:

> RPO

Table 34: RPO Command Output

Field	Description
RPO – Command Output	
Mode Constant	Reports the default video mode set with the OM command

C.1.4 RPA – Report Alpha

This command returns parameters for the alpha setting of the SDI inputs. The command usage is as follows:

RPA

Table 35: RPA Command Output

Field	Description
RPA – Command Output	
Midground Alpha	Midground alpha. The range is 0..255
Foreground Alpha	Foreground alpha. The range is 0..255
Alpha Mode	0 – Constant Alpha, 1 – select visible range, 2 – select transparent range
Foreground Transparent Alpha	Alpha for transparent colors in the foreground.
Color Mode	0 = YCbCr selection; 1 = RGB selection
Cb Lower Limit	Lower Cb color limit in YCbCr selection mode. 0 .. 1023
Cb Upper Limit	Upper Cb color limit in YCbCr selection mode. 0 .. 1023
Cr Lower Limit	Lower Cr color limit in YCbCr selection mode. 0 .. 1023
Cr Upper Limit	Upper Cr color limit in YCbCr selection mode. 0 .. 1023
Y Lower Limit	Lower Y color limit in YCbCr selection mode. 0 .. 1023
Y Upper Limit	Upper Y color limit in YCbCr selection mode. 0 .. 1023
Transparent Edge Effect	0 .. 2
Visible Edge Effect	0 .. 2
Red Value	Red color for RGB selection mode. 0 .. 255
Green Value	Green color for RGB selection mode. 0 .. 255
Blue Value	Blue color for RGB selection mode. 0 .. 255
RGB Color Tolerance	Tolerance for RGB selection mode. 0 .. 255

C.1.5 RPP – Report PiP Parameters

This command returns the parameters for PiP mode. The command usage is as follows:

RPP

Table 36: RPP Command Output

Field	Description
RPP – Command Output	
Position	Returns the PiP position preset in the range 1..9, or 'U' or 'R' if the custom position modes have been set.
Size	Returns the preset PiP size in the $1/16^{th}$ units of the screen size. The range is 1..16
New X	Most recently set custom X position. This value may not have been applied yet
New Y	Most recently set custom Y position. This value may not have been applied yet
New Width	Most recently set custom width. This value may not have been applied yet
New Height	Most recently set custom height. This value may not have been applied yet
X	Custom PiP X position
Y	Custom PiP Y position
Width	Custom PiP width
Height	Custom PiP height
Gap A	Preset PiP position gap to edge (set by PA command)
Gap B	Preset PiP position gap to edge (set by PB command)

C.1.6 RPT – Report Toggle Switch Parameters

This command returns the parameters for the toggle switch. The command usage is as follows:

> RPT

Table 37: RPT Command Output

Field	Description
RPT – Command Output	
enable	Toggle switch enable status 0..1
suspend	Toggle switch suspended status 0..1

C.1.7 RPB – Report Window Parameters for scaler mode

This command returns the parameters of the output video windows in Mode 3. The command usage is as follows:

> RPB

Table 38: RPB Command Output

Field	Description
	RPB – Command Output
X	X position. A percentage ('%') symbol is appended to the number if the window is set in percentage mode
Y	Y position. A percentage ('%') symbol is appended to the number if the window is set in percentage mode
Width	Width. A percentage ('%') symbol is appended to the number if the window is set in percentage mode
Height	Height. A percentage ('%') symbol is appended to the number if the window is set in percentage mode

C.1.8 RPZ – Report Zoom Parameters

This command returns the zoom parameters for the inputs. The command usage is as follows:

RPZ

Table 39: RPZ Command Output

Field	Description
	RPZ – Command Output
PiP Zoom Mode	Zoom mode reports "Window", "Percent", "Percent_2", "Percent_3"
PiP Zoom Factor	Reports 10x the zoom factor used in percentage modes. For example 120% reports as 1200 in this field
PiP Center X	Reports 10x the zoom X center position for the percentage modes
PiP Center Y	Reports 10x the zoom Y center position for the percentage modes
PiP Window X	Reports the X position for zoom window mode
PiP Window Y	Reports the Y position for zoom window mode
PiP Width	Reports the width for zoom window mode
PiP Height	Reports the height for zoom window mode
Scaler Zoom Mode	Zoom Mode reports "Window", "Percent", "Percent_2", "Percent_3"
Scaler Zoom Factor	Reports 10x the zoom factor used in percentage modes. For example 120% reports as 1200 in this field
Scaler Center X	Reports 10x the zoom X center position for the percentage modes
Scaler Center Y	Reports 10x the zoom Y center position for the percentage modes
Scaler Window X	Reports the X position for zoom window mode
Scaler Window Y	Reports the Y position for zoom window mode
Scaler Width	Reports the width for zoom window mode
Scaler Height	Reports the height for zoom window mode

C.1.9 RPL – Report Layer Parameters

This command returns the parameters of the graphic layers. The command usage is as follows:

     RPL

Table 40: RPL Command Output

Field	Description
RPL – Command Output	
Layer 1 Visible	Visibility status: 1= layer 1 is set visible 0 = not visible
Layer 1 Stopped	Stopped status: 1 = layer 1 is stopped and won't be mixed to the output video 0 = layer is activated
Layer 1 Width	Maximum width for layer 1. The actual height used will never exceed the video size
Layer 1 Height	Maximum height for layer 1. The actual height used will never exceed the video size
Layer 1 X	Requested X mix position of layer 1. The actual mix position is always adjusted to fit on the video
Layer 1 Y	Requested Y mix position of layer 1. The actual mix position is always adjusted to fit on the video
Layer 1 Reference Postion	1 = top left corner 2 = center
Layer 2 Visible	Visibility status: 1= layer 2 is set visible 0 = not visible
Layer 2 Stopped	Stopped status: 1 = layer 2 is stopped and won't be mixed to the output video 0 = layer is activated
Layer 2 Width	Maximum width for layer 2. The actual height used will never exceed the video size
Layer 2 Height	Maximum height for layer 2. The actual height used will never exceed the video size
Layer 2 X	Requested X mix position of layer 2. The actual mix position is always adjusted to fit on the video
Layer 2 Y	Requested Y mix position of layer 2. The actual mix position is always adjusted to fit on the video
Layer 2 Reference Postion	1 = top left corner 2 = center
Layer 3 Visible	Visibility status: 1= layer 3 is set visible 0 = not visible
Layer 3 Stopped	Stopped status. 1 = layer 3 is stopped and won't be mixed to the output video

	0 = layer is activated
Layer 3 Width	Maximum width for layer 3. The actual height used will never exceed the video size
Layer 3 Height	Maximum height for layer 3. The actual height used will never exceed the video size
Layer 3 X	Requested X mix position of layer 3. The actual mix position is always adjusted to fit on the video
Layer 3 Y	Requested Y mix position of layer 3. The actual mix position is always adjusted to fit on the video
Layer 3 Reference Postion	1 = top left corner 2 = center

C.1.10 RPU – Report User Interface Parameters

This command returns the parameters of the DIP and Toggle switches. The command usage is as follows:

RPU

Table 41: RPU Command Output

Field	Description
RPU – Command Output	
Dip Switch Mode	0 = Software Priority 1 = Dip Switch Changes 2 = Software Config Priority
DIP enable	Dip switch enabled
Toggle Enable	Toggle switch enabled
DIP1 Mode 1	Dip Switch 1 function for Mode 1
DIP1 Mode 2	Dip Switch 1 function for Mode 2
DIP1 Mode 3	Dip Switch 1 function for Mode 3
DIP1 Mode 4	Dip Switch 1 function for Mode 4
DIP1 Mode 5	Dip Switch 1 function for Mode 5
DIP2 Mode 1	Dip Switch 2 function for Mode 1
DIP2 Mode 2	Dip Switch 2 function for Mode 2
DIP2 Mode 3	Dip Switch 2 function for Mode 3
DIP2 Mode 4	Dip Switch 2 function for Mode 4
DIP2 Mode 5	Dip Switch 2 function for Mode 5
DIP3 Mode 1	Dip Switch 3 function for Mode 1
DIP3 Mode 2	Dip Switch 3 function for Mode 2
DIP3 Mode 3	Dip Switch 3 function for Mode 3
DIP3 Mode 4	Dip Switch 3 function for Mode 4
DIP3 Mode 5	Dip Switch 3 function for Mode 5
DIP4 Mode 1	Dip Switch 4 function for Mode 1
DIP4 Mode 2	Dip Switch 4 function for Mode 2

DIP4 Mode 3	Dip Switch 4 function for Mode 3
DIP4 Mode 4	Dip Switch 4 function for Mode 4
DIP4 Mode 5	Dip Switch 4 function for Mode 5
Toggle Left Mode 1	Toggle Left function for Mode 1
Toggle Left Mode 2	Toggle Left function for Mode 2
Toggle Left Mode 3	Toggle Left function for Mode 3
Toggle Left Mode 4	Toggle Left function for Mode 4
Toggle Left Mode 5	Toggle Left function for Mode 5
Toggle Right Mode 1	Toggle Right function for Mode 1
Toggle Right Mode 2	Toggle Right function for Mode 2
Toggle Right Mode 3	Toggle Right function for Mode 3
Toggle Right Mode 4	Toggle Right function for Mode 4
Toggle Right Mode 5	Toggle Right function for Mode 5

C.1.11 RPC – Report User Interface Parameters

This command returns the parameters of the DIP and Toggle switches. The command usage is as follows:

RPCnn

where nn is the user interface function number in the range 1 through 30, or 0 to return the strings for all 30 functions.

Functions 21 through 30 are reserved for product defaults and cannot be changed by user commands.

Table 42: RPC Command Output

Field	Description
RPC – Command Output (for a single function)	
"Selection 0"	A quoted string containing the command(s) assigned to selection 0
"Selection 1"	A quoted string containing the command(s) assigned to selection 1
"Selection 2"	A quoted string containing the command(s) assigned to selection 2
"Selection 3"	A quoted string containing the command(s) assigned to selection 3
"Selection 4"	A quoted string containing the command(s) assigned to selection 4
"Selection 5"	A quoted string containing the command(s) assigned to selection 5
"Selection 6"	A quoted string containing the command(s) assigned to selection 6
"Selection 7"	A quoted string containing the command(s) assigned to selection 7
"Selection 8"	A quoted string containing the command(s) assigned to selection 8
"Selection 9"	A quoted string containing the command(s) assigned to selection 9
"Selection 10"	A quoted string containing the command(s) assigned to selection 10
"Selection 11"	A quoted string containing the command(s) assigned to selection 11
"Selection 12"	A quoted string containing the command(s) assigned to selection 12
"Selection 13"	A quoted string containing the command(s) assigned to selection 13
"Selection 14"	A quoted string containing the command(s) assigned to selection 14

"Selection 15"	A quoted string containing the command(s) assigned to selection 15

C.1.12 RPS – Report Frame Counter / Line Writer Parameters

This command returns the parameters of the line writer and frame counter The command usage is as follows:

RPS

Table 43: RPS Command Output

Field	Description
RPS – Command Output	
HMSF Hours	Current hours value from the HMSF counter
HMSF Minutes	Current minutes value from the HMSF counter
HMSF Seconds	Current seconds value from the HMSF counter
HMSF Frames	Current frame number from the HMFS counter
Clk Hours	Time clock hours
Clk Minutes	Time clock minutes
Clk Seconds	Time clock seconds
Clk ms	Time clock ms
Frame Count	The current frame count value
Writer Mode	Line writer mode
Drop Count	Indicates if drop counting is enabled for 1000/1001 modes
Defer	Defer buffer swap 1 = yes; 0 = no
"Text"	Line writer text string
Font	Line writer font. This is not the same as graphic field font numbers
X	Line writer X position
Y	Line writer Y position
Red	Red color value 0..255
Green	Green color value 0..255
Blue	Blue color value 0..255
Alpha	Alpha value 0..255
Background Red	Text background Red color value 0..255
Background Green	Text background Green color value 0..255
Background Blue	Text background Blue color value 0..255
Background Alpha	Text background Alpha value 0..255

C.1.13 CRPB – Report GPS Baud Rate Parameters

This command returns the GPS port baud rate. The command usage is as follows:

CRPB

Table 44: CRPB Command Output

Field	Description
CRPB – Command Output	
baud	The baud rate set for the GPS port

C.1.14CRPC – Report GPS Field Setup Parameters

This command returns the parameters for a GPS field. One parameter is required and the command usage is as follows:

> CRPCnn

> where nn is the field number from 1 to 48, or 0 to report all 48 fields.

Table 45: CRPC Command Output

Field	Description
CRPC – Command Output (for one field)	
datafield	The GPS data field to use
formatCode	Format type assigned to the field
formatArg1	Format specific parameter #1
formatArg2	Format specific parameter #2
formatArg3	Format specific parameter #3

C.1.15CRPD – GPS CD Command Parameters

This command returns the parameters of the line writer and frame counter. The command usage is as follows:

> CRPD

Table 46: CRPD Command Output

Field	Description
CRPD – Command Output	
GPSType	GPS device type
EchoChars	Debug character echo enabled status 0..1
EchoString	Debug string echo enabled status 0..1

C.1.16CRPFnn – Report GPS Field Format Strings

This command returns the prefix and suffix strings that can be assigned to graphic fields used for GPS data display. The command usage is as follows:

> CRPFnn

> where nn is the graphic field number from 1 to 48, or 0 to list all fields.

Table 47: CRPF Command Output

Field	Description
CRPF – Command Output (for one field)	
"prefix"	The prefix string, returned inside quotes
"suffix"	The suffix string, returned inside quotes

C.1.17 CRPS – Report the GSP S Command Parameters

This command returns the GPS setup command parameters. The command usage is as follows:

CRPS

Table 48: CRPS Command Output

Field	Description
CRPS – Command Output	
TimeUpdate	Timer update rate in tenths of a second
OverlayNum	The overlay number being used for GPS data display
TimeOffset	GPS Time offset in millseconds. There are numerous ways the commands can set the offset, but it is always stored as milliseconds and returned as such
Time ResyncMode	This is the time resynchronization mode set by the CSM command
TimeResync Threshold	Resync trigger threshold set by the CSR command
CaptureEnable	Reports if the GPS function is enabled to read RS232 data 0..1
UpdateEnable	Reports if the GPS function is enabled to update GPS data fields 0..1
OverlayEnable	Reports if the GPS function is enabled to update graphic fields 0..1
Clear At Start	Reports if graphic fields used for GPS data will be cleared on reset and startup of the DX-2200. Range 0..1
Sync At Start	Reports if linewrite time clock will be synchronized automatically at startup 0..1
Update Same Data	Reports if graphic fields will be updated if new GPS data is the same as previous data
Ignore Checksum Error	Reports the parameter to use GPS data even if the checksum is bad
Set Frame Counter	Reports if the GPS time is also used to set the HMSF counter of the line writer

Appendix D: Regulatory Compliance Information

Equipment Type: Information Technology Equipment

Product: DX-2200-TI, Text Inserter

Model No: DX-2200-xx-xx where xx are any combination of the alphanumeric characters.

NOTE: The DX-2200-TI, HD-SDI Text Inserter product is a sub-set of the DX-2200, 2x1 Dual-view SDI Video Switcher product, a unit which uses the exact same board but has the components for two SDI video inputs installed. The unit was tested for compliance in a DX-2200, 2x1 Dual-view SDI Video Switcher configuration.

D.1 Industry Canada (IC)

The DX-2200, 2x1 SDI Video Switcher product has been tested and found to comply Industry Canada ICES-003, Issue 5, Class A – Information Technology Equipment (ITE), the compliance as suggested by Industry Canada is as follows:

CAN ICES-3 (A)/NMB-3(A)

D.2 Federal Communications Commission (FCC) Declaration of Conformity

Responsible Party: Microtronix Datacom Ltd.

4056 Meadowbrook Drive, Unit 126, London, ON Canada

TEL: +(1) 519-690-0091

The Responsible Party declares the DX-2200, 2x1 SDI Video Switcher product has been tested and found to comply FCC PART 15, SUBPART B, Class A – Unintentional Radiators.

Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

This equipment has been tested and found to comply with the limits for a class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause interference to radio or television reception, which can be determined by turning the equipment OFF and ON, the user is encouraged to try to correct the interference by one or more of the following measures:

- Ensure that all mounting screws, attachment connector screws, and ground wires are tightly secured.
- Reorient the receiving antenna.
- Increase the separation between the equipment and the receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Call the dealer or an experienced radio/TV technician for help.

D.3 CE Declaration of Conformity

(CE Conformity Marking)

I, the undersigned, hereby declare that the equipment as tested is representative within manufacturing tolerance to units and found to comply with the following standard(s):

STANDARD(S) TO WHICH CONFORMITY IS DECLARED:

The **DX-2200, 2x1 SDI Video Switcher product** has been tested in accordance with:

- CISPR 24: 2010 / EN 55024:2010 – Electromagnetic Compatibility Requirements – Information Technology Equipment – Immunity Characteristics – Limits and Methods of Measurements, and

- CISPR 22:2008-09 / EN 55022:2010, Class A – Information Technology Equipment.

The results and observations recorded were in compliance to the requirements.

TEST LABORATORIES: UltraTech Engineering Labs Inc.

3000 Bristol Circle, Oakville, ON, Canada, L6H-6G4

DATE OF ISSUE OF DECLARATION: May 8, 2013

Manufacturer	
Company Name	Microtronix Datacom Ltd
Signature:	Norman McCall
Full Name:	Norman McCall
Title:	President
Address	4056 Meadowbrook Drive, Unit 126
	London, ON, Canada, N6L-1E3
Phone No.:	(+1) 519-690-0091
Email:	nmccall@microtronix.com

WARNING: This is a Class A product.   In domestic environment this product may cause radio interference in which case the user may be required to take adequate measures.

VERIFICATION CERTIFICATE

NOT TRANSFERABLE

This Verification Certificate is hereby issued to the named GRANTEE and is VALID ONLY for the equipment identified hereon for use under the rules and regulations listed below:

GRANTEE: Microtronix Datacom Ltd.
Address: 4056 Meadowbrook Drive, Unit 126
London, Ontario
Canada, N6L 1E3
Contact Person: Mr. Norman McCall
Phone #: 519-690-0091 x264
Fax #: 519-690-0092
Email Address: nmccall@microtronix.com

Equipment Type: Class A Information Technology Equipment (ITE)
Product Name: DX-2200 2x1 SDI Video Switcher,
Model No.: DX-2200-xx-xx where xx are any combination of alphanumeric characters.

The above product was tested by UltraTech Engineering Labs Inc. and found to comply with: Industry Canada ICES-003, Issue 5 - Information Technology Equipment (ITE) — Limits and methods of measurement

Date of Authorization: May 14, 2013

- **Note(s):** See attached report, UltraTech's File No.: MDL-029_ICES-003, dated May 14, 2013 for details and conditions of Verification Compliance.

Approved by: Tri M. Luu BASc.
V.P. – Engineering

UltraTech

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VCI
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Industry Canada
Industrie Canada
Approved Test Facility
46390-2049

NVLAP
NVLAP LAB CODE 200093-0

BSMI
SL2-IN-E-1119R

Korea KCC-RRL
CA2049

VERIFICATION CERTIFICATE

NOT TRANSFERABLE

This Verification Certificate is hereby issued to the named GRANTEE and is VALID ONLY for the equipment identified hereon for use under the rules and regulations listed below:

GRANTEE:
Microtronix Datacom Ltd.

Address:
4056 Meadowbrook Drive, Unit 126
London, Ontario
Canada N6L 1E3

Contact Person:
Mr. Norman McCall
Phone #: 519-690-0091 x264
Fax #: 519-690-0092
Email Address: nmccall@microtronix.com

Equipment Type: Unintentional Radiators for Use in Non-Residential Areas
Product Name: DX-2200 2x1 SDI Video Switcher
Model No.: DX-2200-xx-xx where xx are any combination of alphanumeric characters.

The above product was tested by UltraTech Engineering Labs Inc. and found to comply with: FCC Part 15, Subpart B - Class A Unintentional Radiators for Use in Commercial and Industrial Areas.

Date of Authorization: May 8, 2013

- **Note(s):** See attached report, UltraTech's File No.: MDL-092_FCC15A, dated May 8, 2013 for details and conditions of Verification Compliance.

Approved by: Tri M. Luu BASc.
V.P. – Engineering

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Address: 4056 Meadowbrook Drive, Unit 126
London, Ontario
Canada, N6L 1E3

Contact Person: Mr. Norman McCall
Phone #: 519-690-0091 x264
Fax #: 519-690-0092
Email Address: nmccall@microtronix.com

Equipment Type: Information Technology Equipment
Product Name: DX-2200 2x1 SDI Video Switcher
Model No.: DX-2200-xx-xx where xx are any combination of alphanumeric characters.

The above product was tested by UltraTech Engineering Labs Inc. and found to comply with:
CISPR 24: 2010 / EN 55024:2010 - Electromagnetic Compatibility Requirements - Information Technology Equipment - Immunity Characteristics - Limits and Methods of Measurements

Note(s): See attached report, UltraTech's File No.: MDL-029_EN24, dated May 9, 2013 for details and conditions of Verification Compliance.

Approved by: *Tri M. Luu BASc.*
V.P. – Engineering

UltraTech

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VERIFICATION CERTIFICATE

NOT TRANSFERABLE

This Verification Certificate is hereby issued to the named GRANTEE and is VALID ONLY for the equipment identified hereon for use under the rules and regulations listed below:

GRANTEE: Microtronix Datacom Ltd.

Address: 4056 Meadowbrook Drive, Unit 126
London, Ontario
Canada, N6L 1E3

Contact Person: Mr. Norman McCall
Phone #: 519-690-0091 x264
Fax #: 519-690-0092
Email Address: nmccall@microtronix.com

Equipment Type: Class A - Information Technology Equipment
Product Name: DX-2200 2x1 SDI Video Switcher
Model No.: DX-2200-xx-xx where xx are any combination of alphanumeric characters.

The above product was tested by UltraTech Engineering Labs Inc. and found to comply with: European CISPR 22:2008-09 / EN 55022:2010

Date of Authorization: May 8, 2013

- **Note(s):** See attached report, UltraTech's File No.: MDL-029_CISPR22A, dated May 8, 2013 for details and conditions of Verification Compliance.

Approved by: Tri M. Luu BASc.
V.P. – Engineering

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