

# **Computer-Based Instruments**

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## **NI 5431 Composite Video Generator Software User Manual**

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# Conventions

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The following conventions are used in this manual:

» The » symbol leads you through nested menu items and dialog box options to a final action. The sequence **File»Page Setup»Options** directs you to pull down the **File** menu, select the **Page Setup** item, and select **Options** from the last dialog box.



This icon denotes a note, which alerts you to important information.



This icon denotes a caution, which advises you of precautions to take to avoid injury, data loss, or a system crash.

**bold** Bold text denotes items that you must select or click on in the software, such as menu items and dialog box names and options. Bold text also denotes parameter names and palette names.

*italic* Italic text denotes variables, emphasis, a cross reference, or an introduction to a key concept. This font also denotes text that is a placeholder for a word or value that you must supply.

monospace Text in this font denotes text or characters that you should enter from the keyboard, sections of code, programming examples, and syntax examples. This font is also used for the proper names of disk drives, paths, directories, programs, subprograms, subroutines, device names, functions, operations, variables, filenames and extensions, and code excerpts.

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# Introduction

The National Instruments NI 5431 video generator is a complete composite video generator that has many ways to create and generate arbitrary composite video signals. This manual assumes that you have a good working knowledge of video signal fundamentals and techniques. If you would like some basic information about video signals, see Appendix B, [Video Signal Fundamentals](#). Where other video generators produce fixed patterns, the NI 5431 can create arbitrary patterns including Vertical Insertion Test Signals (VITS) and moving patterns.

You can define your own signal parameters with the many attributes of the video generator instrument driver. For example, these attributes can modify the following:

- Timing parameters such as synchronization pulse rise time or color burst duration
- Level parameters such as synchronization amplitude or color saturation

You can also set the attributes to change dynamic conditions by doing the following:

- Inserting standard or custom-defined filters on all video components
- Adding white noise or distortion to your signal. For example, you can simulate bad signal transmission conditions by adding white noise or distortion to your signal.

Although the NI 5431 is very flexible, you can still generate standard signals using few operations.

You can also completely control the NI 5431 from LabVIEW. An example library, with basic, intermediate, and advanced examples, shows how all of the functions are programmed to give you full access to the NI 5431 functionality. For more information on controlling your NI 5431 from LabVIEW, refer to Chapter 2, [Introductory LabVIEW Programming Examples](#).



## NI 5431 Interface

The NI 5431 composite video generator is a modified version of the NI 5411 arbitrary waveform generator and is, most simply, an arbitrary waveform generator that replays downloaded video data. You can easily create the necessary video data by using the Video Software Toolkit that takes care of the needed calculations and driver functions especially developed to interface between your computer and your NI 5431.

In Figure 1-1, the *User Interface* is the Video Generator Wizard or LabVIEW software applications. You can use either application to generate video signals. The *Hardware Driver* is the NI-FGEN software, which sets up the NI 5431 device that replays downloaded video data. The *Compute Video Data* occurs when the video generation software program, `NI-VDG.dll`, is called to compute the data to be downloaded to the NI 5431. The *Disk Save/Load* represents your computer, which stores saved files generated from the *User Interface* and loads saved files to the NI 5431 device and then generates the analog video signal on the *Analog Video Output Connector*.

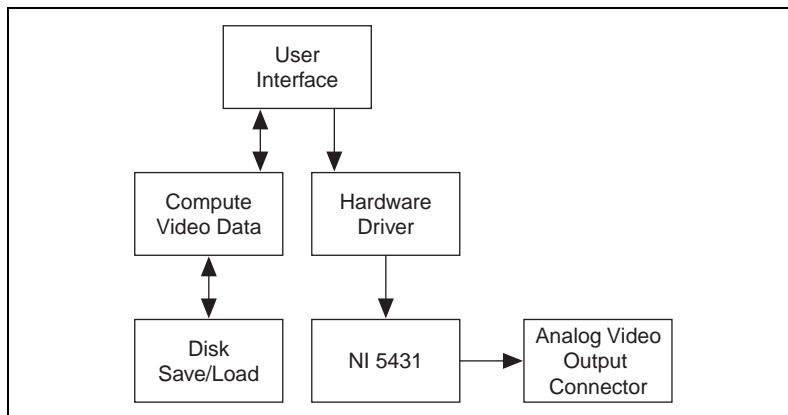


Figure 1-1. NI 5431 System Block Diagram

## Install the Video Software Toolkit

To install the Video Software Toolkit, follow the instructions in the *Where to Start with Your NI 5431*. The installation procedure is performed in two steps using 1) the standard installer CD for the NI-5411 and 2) the video specific CD. The standard installer CDs detect which software programs are already installed on your computer. If you have not already installed the

latest driver software version needed to run the NI 5431, it will prompt you so it can automatically load it onto your system. If LabVIEW is installed on your system, the installer CDs also install video generator VIs that you can use from LabVIEW. These VIs are described in detail in the *NI 5431 Composite Video Generator Help*.

## About the NI 5431

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**Note** The NI 5431 can also generate arbitrary waveforms. Please see the *NI 5411/5431 User Manual* for further details.

The NI 5431 is able to generate all of the common composite video formats including M-NTSC (NTSC), B/G/D/H/I-PAL (Standard-PAL or simply PAL), and L/K-SECAM (SECAM). The simplest way to generate an NTSC, PAL, or SECAM video signal is to use the Video Generator Wizard.

The Video Generator Wizard, a standalone application, is an interactive tool that supports the most common functions of the NI 5431. You can generate standard test patterns or create your own test pattern based on an RGB bitmap image. You can also save to disk calculated video data and recall previously calculated binary video data files. The Video Generator Wizard also gives you access to most of the video attributes and functionality of the NI 5431.

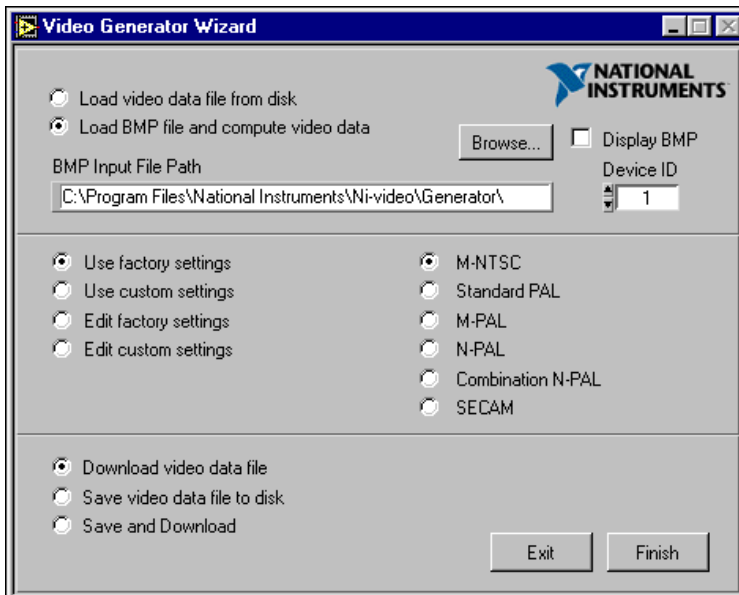
For more detailed information about how the NI 5431 generates video signals and how the Video Software Toolkit filters video components while computing a video signal, see Appendix C, *How the NI 5431 Generates Video Signals*.

## Use the Video Generator Wizard

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To use the Video Generator Wizard, you must first install the NI 5431 device and configure it using Measurement & Automation Explorer. You must also install the Video Software Toolkit. Refer to the *Install the Video Software Toolkit* section or the *Where to Start with Your NI 5431* document for more detailed installation instructions.

After installing the Video Software Toolkit, a Video Generator Wizard shortcut should appear on your desktop. Double-click the `Video Generator Wizard.exe` shortcut on your desktop. The **Video Generator Wizard** dialog box appears as in Figure 1-2.



**Figure 1-2.** Video Generator Wizard Dialog Box  
(Load BMP File and Compute Video Data)

The Video Generator Wizard uses or generates three different file types with the NI 5431 as follows:

- **.bmp**—the bitmap image representing the basic RGB image to be reproduced by the video generator
- **.cfg**—the configuration file where you can save your specific video settings. The video settings include the video parameters or attributes, which are the signal conditions, the video format such as PAL or NTSC, and some other information. You can edit these video settings by choosing the **Edit factory settings** or **Edit custom settings** options in the middle section of the **Video Generator Wizard** dialog box.
- **.bin**—16-bit file format used to save the data of a complete composite video signal. With this file format, you can save or recall binary video data files to or from disk.

When you select the different options in the three main sections of the **Video Generator Wizard** dialog box, you use or generate the three different files described above.

The dialog box is divided into three sections: upper, middle, and bottom. In the upper section, you can select one of two options. The middle and bottom sections change depending upon which option you select in the upper section.

## Load BMP File and Compute Video Data

If you select **Load BMP file and compute video data** in the upper section of the dialog box and select **Use factory settings** in the middle section as shown in Figure 1-2, you can then select the video format you want to generate, such as **M-NTSC**, and create a video signal based on a specified bitmap image file. The factory (default) settings generate a video signal that respects the video norm of your selected video format.

By selecting the **Edit factory settings** option in the middle section of the **Video Generator Wizard** dialog box, you can choose to edit the factory settings for the generated video signal. You can also recall, using the **Use custom settings** option, or recall and edit, using the **Edit custom settings** option, a previously saved configuration file. These options are explained in detail in the [Edit Video Parameters](#) section.

In the bottom section of the dialog box, you can choose to download a binary video data file and start the generation of the video signal, using the **Download video data file** option, and/or save the binary video data file to disk, using the **Save video data file to disk** option. These options are explained in detail in the [Download and Save a Video Data File](#) section.

## Generate a Video Signal

To generate a video signal based on a bitmap image using the factory settings, use the following steps to select the proper options in the upper, middle, and bottom sections in the **Video Generator Wizard** dialog box.

In the upper section, complete the following steps:

1. Make sure that the **Device ID** is set to the correct value (configured by Measurement & Automation Explorer). See step 2 in the *Configure Your NI 5431* section of the *Where to Start with Your NI 5431* document.
2. Select **Load BMP file and compute video data**.
3. Click the **Browse** button.

4. Double-click the appropriate directory from the choices below:
  - For NTSC users, double-click the 640×480 or the 1044×480 directory.
  - For PAL and SECAM users, double-click the 768×576 or the 1040×576 directory.
5. Double-click any of the example .bmp files. The bitmap image file path now appears in the **BMP Input File Path** control.

In the middle section, do the following steps:

6. On the left side, select **Use factory settings**. This option applies the default video parameters to the video signal you are going to generate.
7. On the right side, select **M-NTSC**, **Standard-PAL**, or **SECAM**, depending on the video format you want to generate.

In the bottom section, do the following steps:

8. Select **Download video data file**. This option downloads the binary video data from your computer to the NI 5431 device.
9. Click **Finish**. A **Processing** dialog box appears to show you the processing status.



**Note** If you select the **Display BMP** box next to the **Browse** button, when you click **Finish** in step 9, you will also see the .bmp file displayed on your computer monitor.

Based on the .bmp file you selected, the Video Generator Wizard calculates an NTSC, PAL, or SECAM video data, downloads the calculated data to your NI 5431 device, and automatically starts the generation of the video signal on your analog video output connector.

## Edit Video Parameters

You can also use the Video Generator Wizard to control different video parameters on your video signal.



**Note** The term *parameters* is the non-programmer's name for video signal conditions that you can modify via the Video Generator Wizard using the NI-VDG.dll. The programmer's term *attribute*, is used in Chapter 2 instead of the term *parameters*.



**Note** Select **Load BMP file and compute video data** in the upper section of the **Video Generator Wizard** dialog box to access the following options in the middle section.

To edit different video parameters on your video signal, you can select one of the following options in the middle section of the **Video Generator Wizard** dialog box.

## Edit Factory Settings

When you select **Edit factory settings**, you access most of the editable video parameters. If you edit and then choose to save the edited video parameters, the Video Generator Wizard generates a configuration file. The configuration file stores the edited video parameters, along with some other information, that are used to generate your video signal. To edit these video parameters, do the following steps:

1. Select **Edit factory settings**.
2. On the right side, select **M-NTSC**, **Standard-PAL**, or **SECAM**, depending on the video format you want to generate.
3. Select **Download video data file** in the bottom section of the **Video Generator Wizard** dialog box.
4. Click **Next**.
5. Select the video parameters you want to modify in any of the five displayed tabs as shown in Figure 1-3. An explanation of the five tabs follows.

## Appearance

The **Appearance** tab shown in Figure 1-3 displays the controls for the parameters of your video signal that affect the appearance of the image. For example, you can modify the geometry, such as size and position, and you can modify intensity, such as brightness, contrast, or saturation.

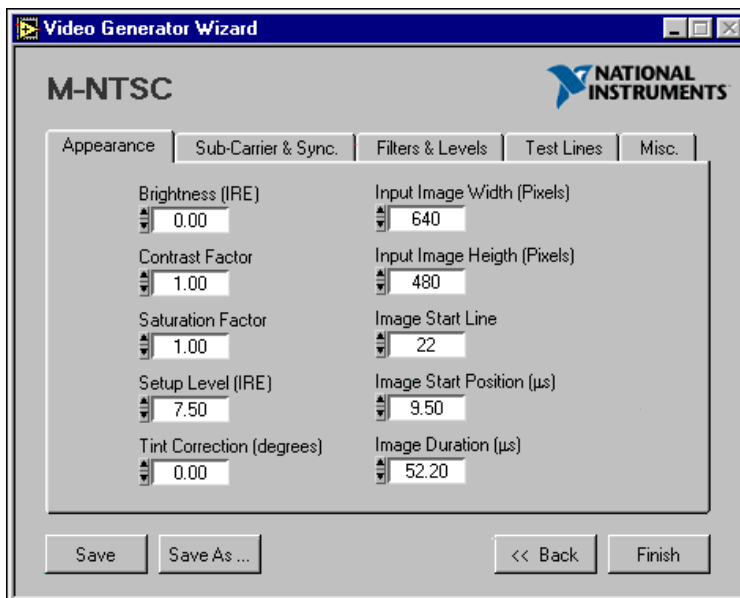
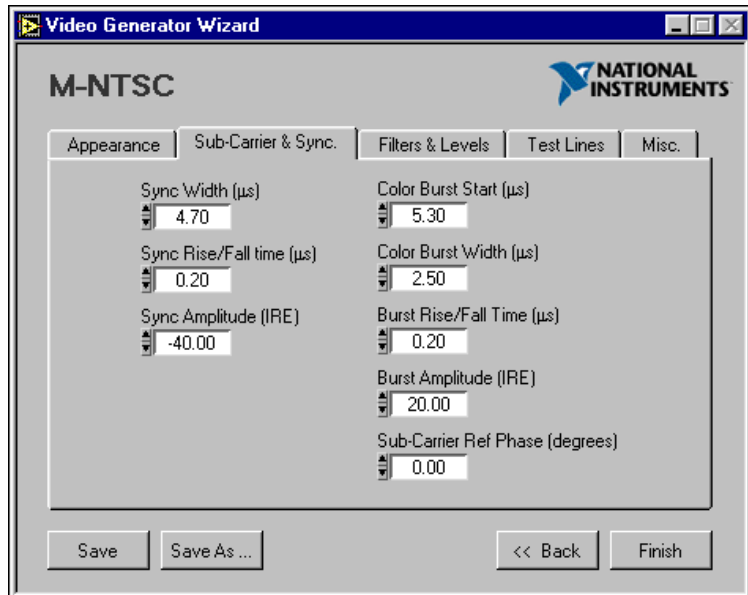


Figure 1-3. Appearance Tab Dialog Box

## Sub-Carrier & Sync.

The **Sub-Carrier & Sync.** tab shown in Figure 1-4 displays the controls for the parameters that control the positioning and level of the composite synchronization pulses and color burst signals.

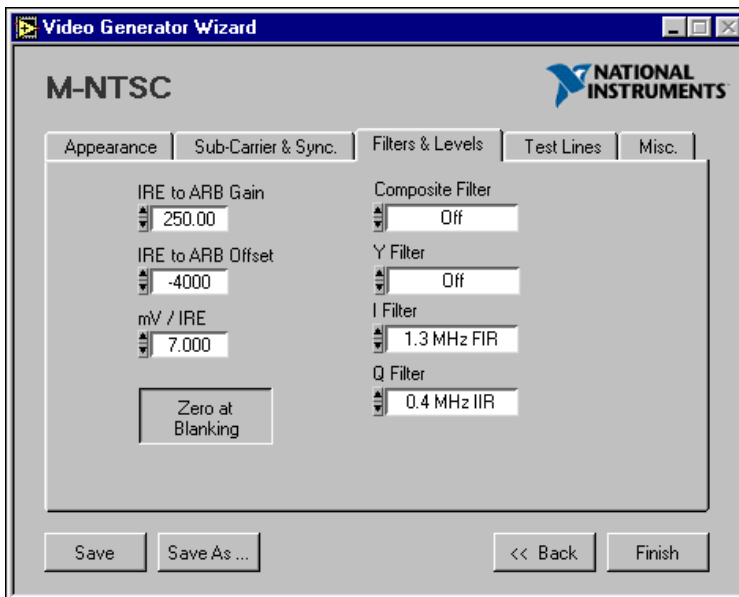


**Figure 1-4.** Sub-Carrier & Sync. Tab Dialog Box



## Filters & Levels

The **Filters & Levels** tab shown in Figure 1-5 displays the controls for the output level and offset of your analog signal and the filter options that can be applied to the different video components that compose your video signal. See *How the Video Software Toolkit Filters Video Components* in Appendix C, *How the NI 5431 Generates Video Signals*, for more detailed information.



**Figure 1-5.** Filters & Levels Tab Dialog Box

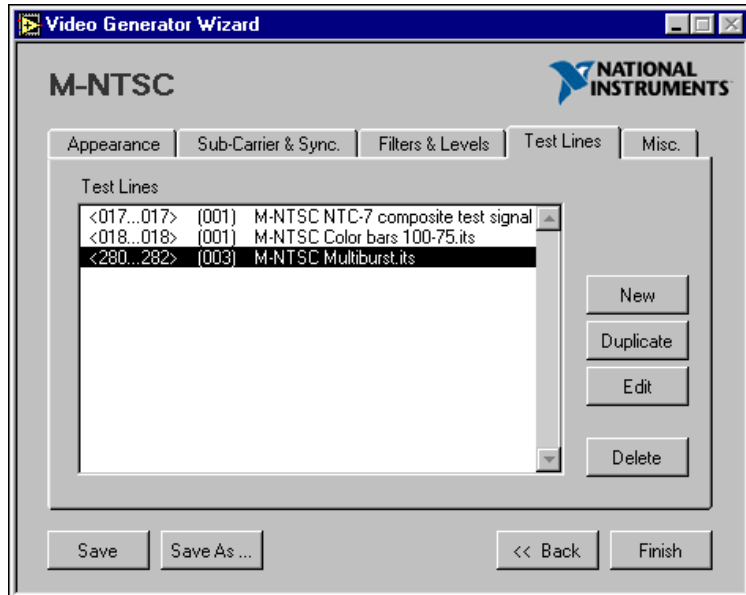


**Note** It is not recommended to change the default values for the **IRE to ARB Gain** and **IRE to ARB Offset** parameters. The default values shown in Figure 1-5 are optimized for best dynamic results of your generator.

## Test Lines

In the **Test Lines** tab shown in Figure 1-6, you can define a list of insertion test signals (ITS) to be inserted on specific lines in your video signal. Using the **New**, **Duplicate**, **Edit**, or **Delete** control buttons, you can do the following:

- Create a new set of lines
- Duplicate or edit an existing set of lines
- Delete a previously defined set of lines



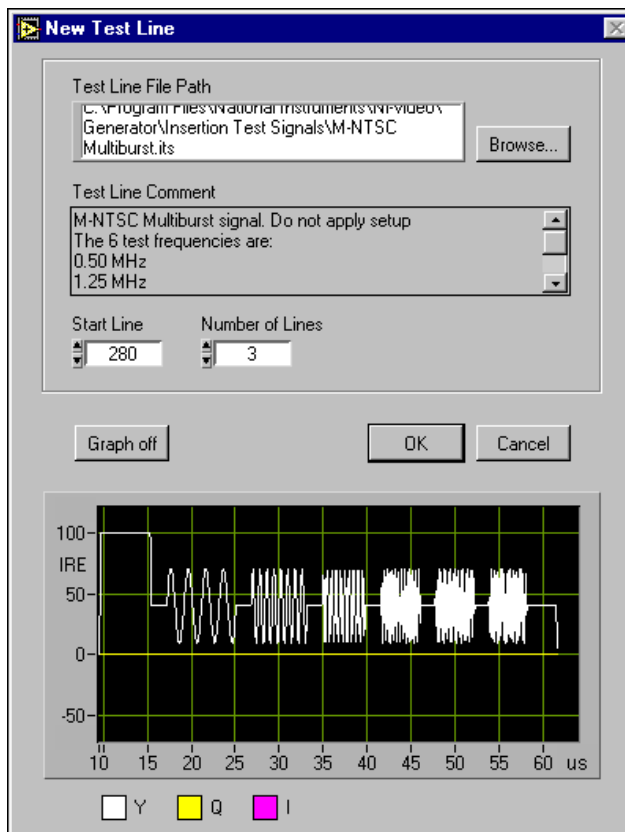
**Figure 1-6.** Test Lines Tab Dialog Box

When you choose to create a new set or edit an existing set of lines, a **New Test Lines** dialog box appears as shown in Figure 1-7. Follow these steps:

1. Using the **Browse** button, double-click the `.its` file to be used, based on the video format you chose in step 2, or type the test line file path in the **Test Line File Path** control.
2. In the **Start Line** control, specify the start line number where the first test line is expected to appear in your video signal.
3. In the **Number of Lines** control, specify the total number of consecutive lines you want to generate.
4. Click **OK** to add or modify the set of test lines to your list, or click **Cancel** if you do not want to apply these changes.



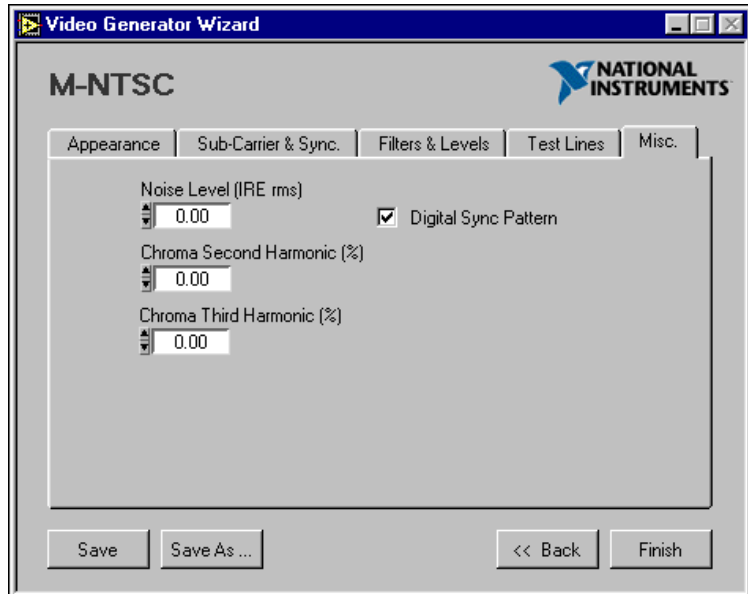
**Note** Due to the interlaced nature of the video signal, a defined set of test lines is inserted in only one field of your video signal. If you want the same set of lines to also be inserted in the other field, click **Duplicate**, then click **Edit**, and change the start line number to the value corresponding to the other field. For example, to duplicate lines from the odd field to the even field, add 263 (for M-NTSC or M-PAL formats) or 313 (for all other formats) to the actual start line value.



**Figure 1-7.** New Test Lines Dialog Box

## Misc.

The **Misc.** tab shown in Figure 1-8 displays the controls for a few miscellaneous parameters that can be modified in your video signal. You can add optional harmonic distortion to your chroma signal using the **Chroma Second Harmonic (%)** and **Chroma Third Harmonic (%)** controls, or you can add white noise to your composite video signal using the **Noise Level (IRE rms)** control.



**Figure 1-8.** Misc. Tab Dialog Box

To complete editing your settings, after going through the Video Generator Wizard tabs, follow these steps:

1. Optionally, you can save your edited configuration, which includes the edited video parameters, the video format you selected, and some other information, from all of the five tabs using either the **Save** or the **Save As** button.
  - a. If you click **Save As**, enter the edited configuration file name, such as `My_config.cfg`.
  - b. Click **Save**.
2. Click **Finish**. A **Processing** dialog box appears showing the processing status.

The Video Generator Wizard calculates a new binary video data file based on the edited configuration, downloads it to the NI 5431, and then starts the generation of the video signal on your analog video output connector. This binary file will not be saved.

## Use Custom Settings

When you select **Use custom settings**, you can recall any previously customized and saved configuration file and apply these settings to a video signal based on any bitmap image that you select in the upper section of the **Video Generator Wizard** dialog box. There are several customized configuration files already installed on your computer. The configuration file that you recall only contains the video parameters, video format, and some other information, and does not refer to a specific bitmap image.

Follow these steps to generate a video signal using previously defined custom settings:

1. Select **Use custom settings**.
2. In the **Settings File Path**, an example file called `NTSC low saturation.cfg` is already selected. This configuration file results in the generation of a video signal with half the normal saturation level that is an image with weak colors. To select any other configuration files, such as `PAL low saturation.cfg` or `SECAM low saturation.cfg`, do the following steps:
  - a. Click **Browse**.
  - b. Double-click the `.cfg` file you want to apply to your video signal.
3. Select **Download video data file** in the bottom section of the **Video Generator Wizard** dialog box.
4. Click **Finish**. A **Processing** dialog box appears showing the processing status.

A new video signal, based on the selected configuration, is computed and downloaded to the NI 5431.

## Edit Custom Settings

When you select **Edit Custom Settings**, you can recall and edit a previously customized and saved configuration file that you created using the **Edit Factory Settings** option or that the installation CD installed in your computer. Follow these steps to recall and edit a previously customized and saved configuration file:

1. Click **Browse** button to select the `.cfg` file you want to edit.

2. Double-click the `.cfg` file you want to edit.
3. Click **Next** to access the video parameters you want to edit.
4. Select the video parameters you want to modify in any of the five displayed tabs shown in Figure 1-3.
5. Optionally, you can save the configuration from all of the five tabs you edited using either the **Save** or the **Save As** button.
  - a. Enter the new name of the edited `.cfg` file, if necessary.
  - b. Click **Save** to save the edited `.cfg` file in the **Configuration files** directory.
6. Click **Finish**. A **Processing** dialog box appears showing the processing status.

A new video signal, based on the edited configuration, is computed and downloaded to the NI 5431.

## Download and Save a Video Data File

To download the calculated video data for your video signal to the NI 5431 device or to save this data to disk, you can select one of the following three options found in the bottom section of the **Video Generator Wizard** dialog box.



**Note** Select **Load BMP file and compute video data** in the upper section of the **Video Generator Wizard** dialog box to access the following options in the bottom section and to produce the following results.

### Download Video Data File

**Download video data file** downloads the binary video data file to your NI 5431 device based on the bitmap image selected in the **BMP Input File Path** control and video settings selected in the middle section in the **Video Generator Wizard** dialog box. The Video Generator Wizard does not save this downloaded binary video data file.

If you select **Use factory settings** in the middle section, go to the [Generate a Video Signal](#) section for the detailed steps to follow. If you select **Use custom settings** in the middle section, go to the [Use Custom Settings](#) section for the detailed steps to follow.

### Save Video Data File to Disk

**Save Video Data File to Disk** generates and saves a binary video data file to your disk. This binary video data file is the result of the calculation based

on the bitmap image selected in the **BMP Input File Path** control and video settings selected in the middle section in the **Video Generator Wizard** dialog box.

To save a binary video data file to disk, follow these steps:

1. If you select **Use factory settings** in the middle section, go to the [Generate a Video Signal](#) section and follow steps 1-7. If you select **Use custom settings** in the middle section, go to the [Use Custom Settings](#) section and follow steps 1-2.
2. In the bottom section of the **Video Generator Wizard** dialog box, select **Save video data file to disk**. A **Save As** dialog box appears.
3. Based on the video format you chose, double-click a directory to save the new binary video data file in.



**Note** You can also enter the path where you want to save the binary video data file in the **Video Output File Path** field, such as in the `video data files\...` directory.

4. Enter a name for the binary video data file, such as `my_bin.bin`.
5. Click **Save**. A **Processing** dialog box appears showing the processing status.

A new binary video data file is saved to your disk.



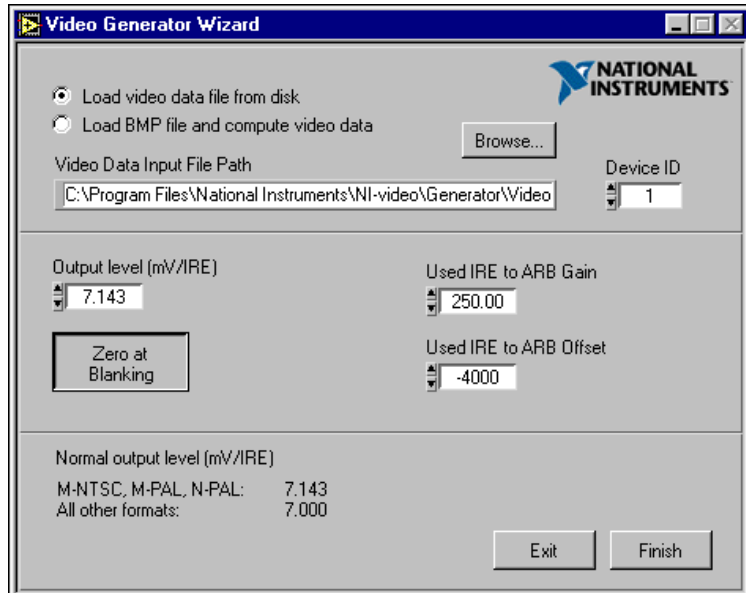
**Note** Once the binary video data file is saved, you can select the **Load Video Data File from Disk** option in the upper section of the **Video Generator Wizard** dialog box to generate a video signal directly from the binary video data file. See the [Load Video Data File from Disk](#) section for further details on using a binary video data file to generate a video signal.

## Save and Download

**Save and Download** combines the **Download Video Data File** and **Save Video Data File to Disk** functions. This option generates and saves a binary video data file to disk, downloads it to the NI 5431 device, then starts generation.

## Load Video Data File from Disk

When you select **Load video data file from disk** in the upper section of the **Video Generator Wizard** dialog box, the middle section changes as shown in Figure 1-9. **Load video data file from disk** downloads a *previously* saved binary video data file to your NI 5431 device and starts generation of the video signal on your analog video output connector.



**Figure 1-9.** Video Generator Wizard Dialog Box  
(Load Video Data File from Disk)



**Note** Only advanced users should alter the **Used IRE to ARB Gain** and **Used IRE to ARB Offset** settings. These settings affect the signal levels generated by the hardware. The values input in these controls should match the values used when the video data file was created and saved. See the note in the *Filters & Levels* section.

To generate a video signal using this option, follow these steps:

1. Select **Load video data file from disk**.
2. Using the **Browse** button, double-click any binary video data file to download from the `Video data files\...` directory, such as `my_bin.bin`, which you generated and saved in the *Save Video Data File to Disk* section.
3. In the middle section, make sure you select the correct value in the **Output level** control that corresponds to the video format previously incorporated into the binary video data file. The nominal value is 7.143 mV/IRE for M-NTSC, M-PAL, and N-PAL, and 7.000 mV/IRE for all other video formats as shown in the bottom section of the dialog box.
4. Click **Finish**, and a **Downloading** dialog box appears, showing the progress of the download. As soon as the dialog box disappears, the video signal should be generated by your NI 5431 device.



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# Introductory LabVIEW Programming Examples

The LabVIEW driver library for the Video Software Toolkit, `NI-VideoDataGen.llb`, contains a large number of VIs that you can use to calculate composite video signals in many different formats.

## Using the Basic LabVIEW Examples

---

After installing your Video Software Toolkit, you can access the LabVIEW VI examples by choosing **Functions»Video Generation»Generator Examples** from the LabVIEW palette.

You can also access the `Composite Video Generator Examples.llb` in the installation drive `...\Program Files\National Instruments\LabVIEW\Examples\Ni-Video` directory. You can access the `NI 5431 High Level Driver.llb` and the `NI-VideoDataGen.llb` in the installation drive `...\Program Files\National Instruments\LabVIEW\Vi.lib\ni-video\generator` directory. The three LabVIEW example libraries are described below:

- `Composite Video Generator Examples.llb`—NTSC, PAL, and SECAM examples using IVI. These VI examples are documented in this chapter.
- `NI 5431 High Level Driver.llb`—High-level IVI-based driver library. These VIs are documented in the *NI 5431 Composite Video Generator Help* file.
- `NI-VideoDataGen.llb`—Low-level driver library. These VIs are documented in the *NI 5431 Composite Video Generator Help* file.



**Note** To access the *NI 5431 Composite Video Generator Help* file, open the VI, and from the LabVIEW menu, click **Help»Online Help for VI name**.

The `Composite Video Generator Examples.llb` library of examples generate composite video signals using a PCI 5431 or a PXI 5431 arbitrary video generator board. Connect the output signal to a video monitor or a

television with video input. You can also use most examples as subVIs directly in your own application.

The different examples show how to do the following:

- Generate a normal PAL, NTSC, or SECAM video signal from a specified bitmap image.
- Create and save to disk a binary file that contains PAL, NTSC, or SECAM video data.
- Load from disk a binary file that contains PAL, NTSC, or SECAM video data, and download the data to the generator.
- Generate a modified PAL, NTSC, or SECAM signal using the video attributes.
- Generate PAL, NTSC, or SECAM signals that contain insertion test signals (ITS).
- Create and save to disk customized high-accuracy ITS.
- Create custom filters for the different luma and chroma components.

To learn how to use and program the different functions of your video generator, you should try the different examples described in the rest of this chapter in the order in which they appear.



**Note** When using the following LabVIEW examples, NTSC, PAL, and SECAM users should select the bitmap image files depending upon the video format you want to generate.

The main file path for all bitmap files is `... \Program Files \National Instruments \NI-video \Generator \BMPs \...` The appropriate directories for the three different user types are as follows:

- NTSC users—Select any bitmap image file found in the `... \640x480` or `... \1044x480` directories. The recommended file is the NTSC test pattern 01 1044x480.bmp, located in the `... \1044x480` directory.
- PAL users—Select any bitmap image file found in the `... \768x576` or `... \1040x480` directories. The recommended file is the B-PAL test pattern 01 1040x576.bmp, located in the `... \768x576` or `... \1040x576` directories.
- SECAM users—Select any bitmap image file found in the `... \768x576` or `... \1040x576` directories. The recommended file is the SECAM test pattern 01 1040x576.bmp, located in the `... \1040x576` directory.

## Generate a Standard Video Signal

This Basic Create Composite Signal from BMP Image VI generates an NTSC, PAL, or SECAM data array, depending on the selected video format, downloads the data to the NI 5431, and automatically starts the generation of the video signal.

You can access this VI example in the LabVIEW palette by choosing **Functions»Video Generation»Generator Examples»Basic create composite signal from BMP image**.

To generate a standard video signal, follow these steps:

1. After selecting the example VI icon in the LabVIEW palette, click the LabVIEW diagram to place the icon there. Double-click the VI example icon to open it in LabVIEW.



**Note** You can also access this VI from the installation drive by double-clicking the `Composite Video Generator Examples.llb` library. The **File Dialog** box appears. Click **Basic create composite signal from BMP image.vi**, then click **OK**. The VI opens in LabVIEW.

2. Make sure the **Device ID** control value matches the value assigned by the Measurement and Automation Explorer during configuration of the board. See the *Configure and Test Your NI 5431* section in the *Where to Start with Your NI 5431* documentation for further details.
3. On the front panel of the VI, using the LabVIEW palette operating tool and the up and down arrows on the **Video type** control, select the appropriate video format.
4. Run the VI. An **Input BMP File ?** dialog box appears, prompting you to select the bitmap image file to convert to video.
5. Double-click the `BMPs` shortcut to browse in the appropriate subdirectory for the appropriate bitmap image file based on the video format you chose in step 3. See the [Using the Basic LabVIEW Examples](#) section for more details.
6. Double-click the subdirectory, then double-click a `.bmp` file.



**Note** To avoid being prompted for the bitmap image file, type the file path in the **Input BMP file path** control before running the VI.

After a few seconds, a video signal should start generating.

## Save a Video Signal to Disk

The Basic Create Video File from BMP Image and Save VI only saves the calculated NTSC, PAL, or SECAM data array. It does not download the data array to the hardware.

You can access this VI example in the LabVIEW palette by choosing **Functions»Video Generation»Generator Examples»Basic create video file from BMP image and save**.

To save the calculated data array, follow these steps:

1. After selecting the example VI icon in the LabVIEW palette, click the LabVIEW diagram to place the icon there. Double-click the VI example icon to open it in LabVIEW.



**Note** You can also access this VI from the installation drive by double-clicking the `Composite Video Generator Examples.llb` library. The **File Dialog** box appears. Click **Basic create video file from BMP image and save.vi**, and click **OK**. The VI opens in LabVIEW.

2. On the front panel of the VI, using the LabVIEW palette operator tool and the up and down arrows on the **Video type** control, select the appropriate video format.
3. Run the VI. An **Input BMP File ?** dialog box appears, prompting you to select the bitmap image file to convert to a binary video data file.
4. Double-click the `BMPs` shortcut to browse in the subdirectories for the appropriate bitmap image file based on the video format you chose in step 2. See the [Using the Basic LabVIEW Examples](#) section for more details.
5. Double-click a subdirectory, and then double-click a `.bmp` file. An **Output BIN file ?** dialog box appears.
6. Double-click the `Video data files` shortcut to access the appropriate subdirectories. Select the subdirectory based on the video format you selected in the **Video type** control. The new binary video data file is saved in this subdirectory.
7. Enter a `.bin` file name for the new binary video data file being saved.



**Note** To avoid being prompted for the file paths, enter the file paths in the **Input BMP file path** control and the **Output video binary file path** control before running the VI.

8. Click **Save**. A new binary video data file is created and saved in the `Video data files\...` subdirectory you selected in step 6.

## Generate a Saved Video Signal

The Download Video File to NI-5431 VI downloads a binary video data file, such as the file you saved using the example VI in the [Save a Video Signal to Disk](#) section, to the NI 5431 and automatically starts the generation of a video signal. The VI automatically detects the **Video type** from the size of the file and adjusts the pixel frequency to the **Video type**.

You can access this VI example in the LabVIEW palette by choosing **Functions»Video Generation»Generator Examples»Download video file to NI 5431**.

To generate a saved video signal, follow these steps:

1. After selecting the example VI icon in the LabVIEW palette, click the LabVIEW diagram to place the icon there. Double-click the VI example icon to open it in LabVIEW.



**Note** You can also access this VI from the installation drive by double-clicking the `Composite Video Generator Examples.llb` library. The **File Dialog** box appears. Click **Download video file to NI-5431.vi**, and click **OK**. The VI opens in LabVIEW.

2. Make sure the **Device ID** control value matches the value assigned by the Measurement and Automation Explorer during configuration of the board. See the *Configure and Test Your NI 5431* section in the *Where to Start with Your NI 5431* documentation for further details.

The **Output Level** control should be set to the default analog output level corresponding to the generated video format. The default analog output level is set to 7.000 mV/IRE, which is the normal value for all formats except NTSC, M-PAL, and N-PAL. For these three video formats, the default value should be 7.143 mV/IRE.



**Caution** You should be careful modifying this **Output Level** control. For example, the NI 5431 can output up to 5 V in a 75  $\Omega$  load, resulting in the potential destruction of your unit under test.

3. Run the VI. A **Video bin file ?** dialog box appears, prompting you to select a subdirectory that is storing the binary video data file to be downloaded.
4. Double-click the `video data files` shortcut to access the appropriate subdirectories. Select the next subdirectory based on the video format of the binary video data file you want to download.
5. Double-click the `.bin` file you want to download.

A saved video signal is downloaded to your NI 5431 and the video signal starts generating.

The **DigiSync** control enables or disables the digital output data lines on the board.



**Note** Select **enabled** on the **DigiSync** control only if your application needs the four TTL video synchronization signals.

When you select **enabled** on the **DigiSync** control, the VI inserts four digital synchronization signals in order—composite sync (Csync), horizontal sync (Hsync), vertical sync (Vsync), and field identification (Field ID)—into the four least significant bits of your video data. The video data is created and/or saved as 16-bit data, but only 12 of these bits are used to generate the analog video signal. When you create the four digital synchronization signals, it does not affect your analog signal quality.



**Note** Refer to the *NI 5411/5431 User Manual* for information on the location of these TTL signals on the digital output connector of your NI-5431.



**Note** The VI example in the *Save a Video Signal to Disk* section does not include the synchronization signals in your saved file.

When the VI runs, the video format of the binary video data file is detected and displayed in the **Detected video format** control.

## Using the Intermediate LabVIEW Examples

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The intermediate LabVIEW examples enable you to customize the video signal using the video attributes and enable you to insert precision test signals in the video signal.

### Generate a Customized Video Signal Using the Video Attributes

The Intermediate Create Composite Signal from BMP Image VI is equivalent to the Basic Create Composite Signal from BMP Image VI in the *Generate a Standard Video Signal* section, except that you can modify an arbitrary number of video attributes and insert digital synchronization patterns into your video data.

You can access this VI example in the LabVIEW palette by choosing **Functions»Video Generation»Generator Examples»Intermediate create composite signal from BMP image**.

Video attributes, which are the parameters of your video signal, can be modified. In this VI, the **Attribute list** control is an array of clusters. Each element in the array corresponds to an attribute that can be modified. The clusters contain two simple controls on the front panel of the VI.

To modify the video attributes, follow these steps:

1. After selecting the example VI icon in the LabVIEW palette, click the LabVIEW diagram to place the icon there. Double-click the VI example icon to open it in LabVIEW.



**Note** You can also access this VI from the installation drive by double-clicking the `Composite Video Generator Examples.llb` library. The **File Dialog** box appears. Click **Intermediate create composite signal from BMP image.vi**, then click **OK**. The VI opens in LabVIEW.

2. Make sure the **Device ID** control value matches the value assigned by the Measurement and Automation Explorer during configuration of the board. See the *Configure and Test Your NI 5431* section in the *Where to Start with Your NI 5431* documentation for further details.
3. On the front panel of the VI, using the LabVIEW palette operator tool and the up and down arrows on the **Video type** control, select the appropriate video format.
4. In the **Attribute list** data array control, click any one of the three **Attribute** controls that you want to modify, and choose the attribute by name. If you need to change more than three attributes, scroll down the array using the **Index** control on the left side of the **Attribute list** data array control.
5. In the **Attribute list** data array control, input the attribute values in the **Value** control. This example VI shows three default cases:
  - Synchronization amplitude (**Sync amplitude (IRE)**) set to the value 40 IRE (the default for PAL/SECAM = 43; the default for NTSC = 40)
  - Synchronization pulses duration (**Sync duration (us)**) set to the value 4.7  $\mu$ s (the default value for all video standards)
  - Contrast factor (**Contrast**) set to the value 1.00 (the default value for all video standards)

When you select **enable** on the **Digital sync** control, the VI inserts four digital synchronization signals in order—composite sync (Csync), horizontal sync (Hsync), vertical sync (Vsync), and field identification (Field ID)—into the four least significant bits of your video data. The video

data is created and/or saved as 16-bit data, but only 12 of these bits are used to generate the analog video signal. When you create the four digital synchronization signals, it does not affect your analog signal quality.

The four signals can be accessed as standard TTL signals on the digital output connector of your NI 5431.



**Note** To generate these signals, enable both the computation and the digital output of your NI 5431.

6. Run the VI. An **Input BMP file ?** dialog box appears, prompting you to select a bitmap image file.
7. Double-click the **BMPs** shortcut to browse for the appropriate bitmap image file according to the video format you chose in step 3. See the [Using the Basic LabVIEW Examples](#) section for more details.
8. Double-click the appropriate subdirectory, then double-click a **.bmp** file.



**Note** To avoid being prompted for the file, type the bitmap image file path in the **Input BMP file path** control before running the VI.

After a few seconds, a video signal with the modified attributes should start generating.

## Insert Test Signals in Your Video Signal

The Intermediate Insert ITS in Composite Signal VI shows you how to include insertion test signals in your video signal. An ITS is typically inserted in the vertical blanking period of the video signal, but this is not a restriction. In fact, you can build an entire video signal using ITS. This allows you to keep full control of and accuracy on the data you are generating. Also, some ITS cannot be generated from RGB data such as a signal with a luminance value of zero, but a saturation value different from zero. See the [Create Insertion Test Signals Using RGB Mode](#) and the [Create Insertion Test Signals Using YUV Mode](#) sections for more information on how to create an ITS.

You can access this VI example in the LabVIEW palette by choosing **Functions»Video Generation»Generator Examples»Intermediate insert ITS in composite signal**.

To insert test signals in your video signal, follow these steps:



1. After selecting the example VI icon in the LabVIEW palette, click the LabVIEW diagram to place the icon there. Double-click the VI example icon to open it in LabVIEW.



**Note** You can also access this VI from the installation drive by double-clicking the `Composite Video Generator Examples.llb` library. The **File Dialog** box appears. Click **Intermediate insert ITS in composite signal.vi**, then click **OK**. The VI opens in LabVIEW.

2. Make sure the **Device ID** control value matches the value assigned by the Measurement and Automation Explorer during configuration of the board. See the *Configure and Test Your NI 5431* section in the *Where to Start with Your NI 5431* documentation for further details.
3. On the front panel of the VI, using the LabVIEW palette operator tool and the up and down arrows on the **Video type** control, select the appropriate video format.
4. Run the VI. An **Input BMP File ?** dialog box appears, prompting you for the bitmap image file to convert to a binary video data file.
5. Double-click the `BMPs` shortcut, then double-click the appropriate subdirectory based on the video format you chose in step 3. An **Input ITS file ?** dialog box appears.
6. Double-click the `Insertion test signals` shortcut to browse for the appropriate insertion test signals file based on the video format you chose in step 3.
7. Double-click a subdirectory, then double-click an `.its` file.
8. The VI will by default insert an ITS on line 19.

If your video monitor does not have options that allow you to see the vertical blanking lines (cross-pulse mode), modify the **Line number** control from 19 to a higher value such as 50. The ITS line in the upper part of your video image appears.

## Create Insertion Test Signals Using RGB Mode

The Create RGB Color Bars Insertion Test Signal VI shows you how to create an ITS data file based on RGB data. The example creates an RGB color bar test pattern and saves the data as a file called `test create RGB ITS.its`. The file can then be recalled using the Intermediate insert ITS in composite signal VI.

You can access this VI example in the LabVIEW palette by choosing **Functions»Video Generation»Generator Examples»Create RGB color bars Insertion Test Signal**.

To generate an RGB Insertion Test Signal, follow these steps:

1. After selecting the example VI icon in the LabVIEW palette, click the LabVIEW diagram to place the icon there. Double-click the VI example icon to open it in LabVIEW.



**Note** You can also access this VI from the installation drive by double-clicking the `Composite Video Generator Examples.llb` library. The **File Dialog** box appears. Click **Create RGB color bars Insertion Test Signal.vi**, then click OK. The VI opens in LabVIEW.



**Note** This VI has predefined parameters for demonstration purposes. If you have not installed your software in your C: drive root directory, correct the file path of the ITS signal to be saved on the VI front panel so it matches your installation.

2. Make sure the **Device ID** control value matches the value assigned by the Measurement and Automation Explorer during configuration of the board. See the *Configure and Test Your NI 5431* section in the *Where to Start with Your NI 5431* documentation for further details.
3. Run the VI. The RGB ITS appears in the VI's front panel and the ITS data are saved on your disk. See the attribute list description in Appendix A, *LabVIEW Attribute List*, or Appendix C, *How the NI 5431 Generates Video Signals* for more details.

An RGB ITS is defined as three data arrays (R, G, and B) of unsigned 16-bit data (U16). The size of the arrays depends on the selected video format and the specified active video duration, which can be modified using the **Image duration (µs)** attribute. The default value for an NTSC signal is 52.2 µs, corresponding to approximately 1,044 samples at the nominal sampling frequency of 20.013 MHz. For B-PAL and SECAM, the default active video duration is 52.0 µs, corresponding to 1,040 samples at the nominal sampling frequency of 20.000 MHz. See the attribute list description in Appendix A, *LabVIEW Attribute List*, for more details.

Therefore, the default size of the array is 1,044 for M-NTSC and 1,040 for 50 Hz-type PAL or SECAM. The data are scaled so that 0 corresponds to black or 0 IRE (if no setup is applied), and 65,535 (the maximum value for unsigned 16-bit data) corresponds to white or 100 IRE.

## Create Insertion Test Signals Using YUV Mode

The Create YUV Color Sweep Insertion Test Signal VI shows you how to create an ITS data file based on YQI/YUV data. Some test patterns are easier to create using the two chroma components (Q and I for NTSC, or U and V for PAL) than using an RGB approach. In other cases, the test signal simply cannot be created using RGB signals.

This VI example creates a color sweep test pattern and saves the data as a file called `test create YUV ITS.its`. The file can then be recalled using the Intermediate Insert ITS in Composite Signal VI.

You can access this VI example in the LabVIEW palette by choosing **Functions»Video Generation»Generator Examples»Create YUV color sweep Insertion Test Signal**.

To generate and save a color sweep test pattern, follow these steps:

1. After selecting the example VI icon in the LabVIEW palette, click the LabVIEW diagram to place the icon there. The **File Dialog** box appears. Double-click the VI example icon to open it in LabVIEW.



**Note** You can also access this VI from the installation drive by double-clicking the `Composite Video Generator Examples.llb` library. Click **Create YUV color sweep Insertion Test Signal.vi**, then click **OK**. The VI opens in LabVIEW.

2. On the front panel of the VI, using the LabVIEW palette operator tool and the up and down arrows on the **Video type** control, select the appropriate video format.
3. Make sure the **Device ID** control value matches the value assigned by the Measurement and Automation Explorer during configuration of the board. See the *Configure and Test Your NI 5431* section in the *Where to Start with Your NI 5431* documentation for further details.



**Note** This VI has predefined parameters for demonstration purposes. If you have not installed your software in your C: drive root directory, correct the file path of the ITS signal to be saved on the VI front panel so it matches your installation.

4. Run the VI. The YUV Insertion Test Signal appears in the VI front panel and the ITS data are saved on your disk.

A YQI/YUV ITS is defined as three data arrays (Y, Q, and I for NTSC; Y, U, and V for PAL; and Y, Db, and Dr for SECAM) of 16-bit data. The luma Y signal is represented by a 16-bit unsigned array (U16) while the

chroma components (Q and I or U and V) are represented by 16-bit signed arrays (I16). The size of the arrays depends on the selected video format and the specified active video duration, which can be modified using the attribute **Image duration (μs)**. The default value for an NTSC signal is 52.2 μs, corresponding to approximately 1,044 samples at the nominal sampling frequency of 20.013 MHz. For B-PAL or SECAM, the default active video duration is 52.0 μs, corresponding to 1,040 samples at the nominal sampling frequency of 20.000 MHz. See Appendix A, [LabVIEW Attribute List](#), for more details.

Therefore, the default size of the array is 1,044 for M-NTSC and 1,040 for 50 Hz-type PAL or SECAM. For the luma signal Y, the data are scaled so that 0 corresponds to black or 0 IRE (if no setup is applied), and 65,535 (the maximum value for unsigned 16-bit data) corresponds to white or 100 IRE. For the chroma component signals, the data are scaled so ± 50 IRE corresponds to ± 32,767 (the maximum and minimum values for signed 16-bit data).



**Note** For SECAM users, the terminology used in this LabVIEW example is based on the PAL chroma components U and V. However, these components are internally scaled so they correspond to the usual Db and Dr components when a SECAM image generates.

The scaling factors used internally are in order as follows:

$$Db = 1.505 * (Eb - Ey) = +3.0527 * U$$

$$Dr = -1.902 * (Er - Ey) = -2.1688 * V$$

Also, because a modulation is always present in SECAM, even if the U and V components are set to zeros, an option for generation of the Y component only (without the FM subcarrier) is available on the front panel of the VI. Enable the **Kill Chroma Modulation** control if you do not want the FM subcarrier signal to be generated on your test signal.

# Using the Advanced LabVIEW Example

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This section describes the advanced LabVIEW VI example.

## Create Many Lines Using ITS and Apply User-Defined Filters

The Advanced Color Bars from ITS with Custom Filters VI shows you how to repeat a specific ITS-defined line to create a whole image or a portion of an image. It also shows how to define and apply user-specific filters. This VI can create, download, and generate M-NTSC, Standard-PAL, or SECAM signals.

You can access this VI example in the LabVIEW palette by choosing **Functions»Video Generation»Generator Examples»Advanced Color bars from ITS with custom filters**. To repeat a specific ITS-defined line to create an image, follow these steps:

1. After selecting the example VI icon in the LabVIEW palette, click the LabVIEW diagram to place the icon there. The **File Dialog** box appears. Double-click the VI example icon to open it in LabVIEW.



**Note** You can also access this VI from the installation drive by double-clicking the `Composite Video Generator Examples.llb` library. Click **Advanced Color bars from ITS with custom filters.vi**, then click **OK**. The VI opens in LabVIEW.

2. Make sure the **Device ID** control value matches the value assigned by the Measurement and Automation Explorer during configuration of the board. See the *Configure and Test Your NI 5431* section in the *Where to Start with Your NI 5431* documentation for further details.
3. On the front panel of the VI, using the LabVIEW palette operator tool and the up and down arrows on the **Video type** control, select the appropriate video format.
4. Run the VI.

The result shows an image that contains 200 color bar lines. The color bars are defined as in the [Create Insertion Test Signals Using RGB Mode](#) section. Furthermore, this example shows you how to define and apply custom FIR filters. The luma and chroma components are filtered using FIR filters without overshoot in the step response. The filter coefficients, represented by the impulse response of an FIR filter, are calculated using the example Calculate Zero-Overshoot Lowpass Filter VI. When you apply a step signal to the different filters, you get a smooth and symmetrical edge without any overshoot. See the front panel of the subVI for more details on the filter step response and frequency characteristics.



# LabVIEW Attribute List

This appendix lists and describes the LabVIEW attributes and their default value depending on the standard video type in Table A-1.

**Table A-1.** Attribute List

Attribute Name	Value	Description	Unit	Default Value
SYNC_AMPLITUDE (IRE)	double*	Level of the synchronization pulses. The sync level is negative. A positive value will be inverted by the software.	IRE	NTSC: -40 SECAM: -40 Std PAL: -43 M-PAL: -40 N-PAL: -40 Comb N-PAL: -43
ZERO_LEVEL (IRE)	double*	Level of zero or blanking.	IRE	0
SETUP_LEVEL (IRE)	double*	Level of black. The value indicates the setup level, that is the difference between blanking and black.	IRE	NTSC: 7.5 Std PAL: 0.0 SECAM: 0.0 M-PAL: 7.5 N-PAL: 7.5 Comb N-PAL: 0
WHITE_LEVEL (IRE)	double*	Level of white.	IRE	100.00
SAMPLING_FREQUENCY (Hz)	double*	Sampling frequency of the generator.	Hz	NTSC: 20.013986 M-PAL: 20.013986 others:20.000000
SAMPLES_PER_LINE	int	Number of samples in a video line.	sample	NTSC: 1272 M-PAL: 1272 others:1280
REFERENCE_LINE	int	Number of the line that starts at the vertical sync edge.	line	NTSC: 4 M-PAL: 4 others: 1
SYNC_DURATION (US)	double*	Duration of the HSync pulse.	$\mu$ s	4.7
SYNC_START (US)	double*	Where the falling edge of sync signal reach 50% of the sync level.	$\mu$ s	0.00

**Table A-1.** Attribute List (Continued)

Attribute Name	Value	Description	Unit	Default Value
SYNC_RISETIME (US)	double*	Time between 10% to 90% of the sync level.	μs	0.2
BURST_DURATION (US)	double*	Duration of the color burst.	μs	Std PAL: 2.25 SECAM: 2.25 N-PAL: 2.25 others: 2.5
BURST_START (US)	double*	Where the amplitude of the color burst signal reach 50% of BURST_AMPLITUDE.	μs	NTSC : 5.3 N-PAL: 5.8 others: 5.6
BURST_RISETIME (US)	double*	10% to 90% rise time of the color burst signal.	μs	0.2
BURST_AMPLITUDE (IRE)	double*	Amplitude of the color burst.	IRE	NTSC: 20.0 others: 21.4
SUBCARRIER_PERIODS_PER_LINE	double*	Number of periods of the chroma subcarrier in a video line.	periods	NTSC: 227.5000 Std PAL: 283.7516 M-PAL: 227.2500 CombN-PAL: 229.2516 (not applicable for SECAM)
SUBCARRIER_START_PHASE (DEG)	double*	Color modulation start phase.	degrees	0.00
SUBCARRIER_SECOND_HARMONIC (%)	double*	Color modulation second harmonic distortion.	%	0.00 (not applicable for SECAM)
SUBCARRIER_THIRD_HARMONIC (%)	double*	Color modulation third harmonic distortion.	%	0.00
BRIGHTNESS (IRE)	double*	Brightness value added the Y signal.	IRE	0.00
CONTRAST	double*	Contrast factor.	none	1.00
SATURATION	double*	Saturation factor.	none	1.00
TINT(DEG)	double*	Hue offset angle (NSTC only).	degree	0.00
GAMMA	double*	Gamma correction factor.	none	1.00
IMAGE_INTERLACED	int	Is the image interlaced.	no/yes	1 (yes)

Table A-1. Attribute List (Continued)

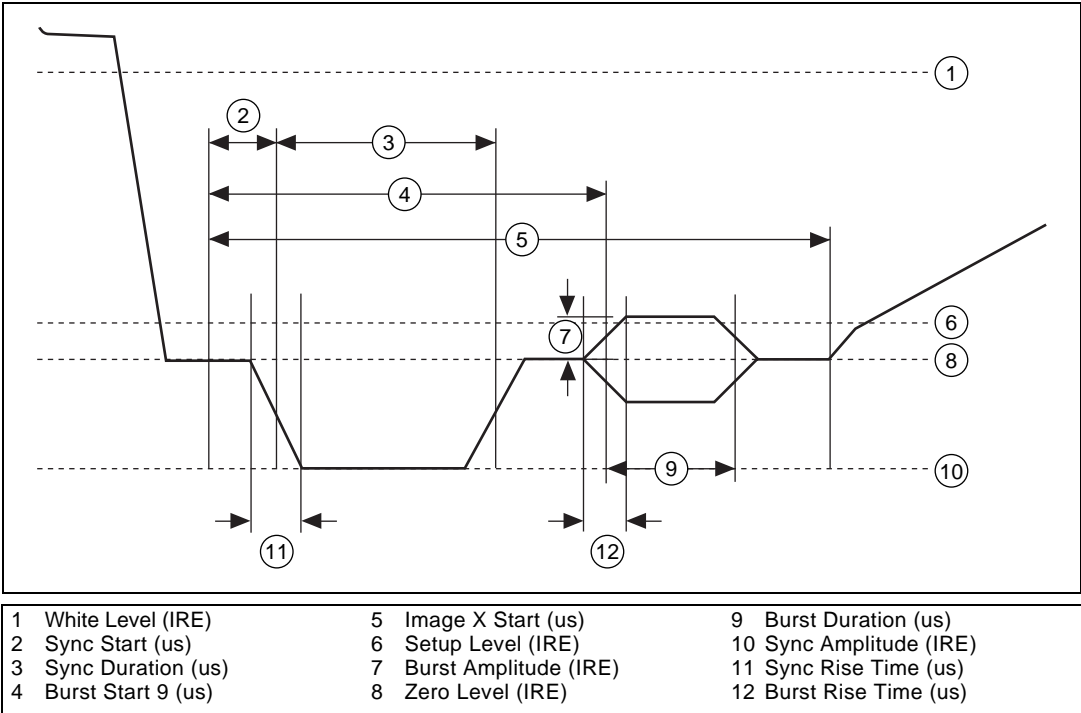
Attribute Name	Value	Description	Unit	Default Value
IMAGE_TOP (LINES)	int	Line number where the image starts in the video frame.	line	NTSC: 22 M-PAL: 22 others: 21
IMAGE_HEIGHT (LINES)	int	Number of line of the image to be used.	line	NTSC: 480 M-PAL: 480 others: 576
IMAGE_X_START (US)	double*	Specify the time from the beginning of each line where the active image starts.	μs	Std PAL: 10.5 SECAM: 10.5 CombN-PAL: 10.5 others: 9.5
IMAGE_DURATION (US)	double*	Specify the duration of the active image on each line.	μs	NTSC: 52.2 M-PAL: 52.2 N-PAL: 53.0 others: 52.0
IMAGE_WIDTH (PIXELS)	int	Number of line pixels of the image to be used.	pixel	NTSC: 640 M-PAL: 640 others: 768
INPUT_GAIN	double*	Used only with 16-bit pixels as input data.	none	100 IRE/65535 1sb = 1.5259E-3
INPUT_OFFSET	double*	Used only with 16-bit pixels as input data.	none	0
OUTPUT_GAIN	double*	Used only with 16-bit pixels as output data.	none	25000 1sb/100 IRE = 250
OUTPUT_OFFSET	double*	Used only with 16-bit pixels as output data.	none	-4000 1sb
NOISE_LEVEL (IRE RMS)	double*	Level of white noise to be added to the generated signal.	IRE rms	0.00
DIGITAL_DELAY (PIXELS)	int	Delay between the analog sync and the digital sync signals.	samples	28
FIELD_POLARITY	int	Field digital signal polarity.	Logical	0 (negative)
Y_FILTER	int	Lowpass filter used for the Y component.	filter <sup>1</sup>	none
UV_FILTER	int	Lowpass filter used for the U and V components.	filter <sup>1</sup>	1.3 MHz IIR



**Table A-1.** Attribute List (Continued)

Attribute Name	Value	Description	Unit	Default Value
I_FILTER	int	Lowpass filter used for the I component.	filter <sup>1</sup>	1.3 MHz IIR
Q_FILTER	int	Lowpass filter used for the Q component.	filter <sup>1</sup>	0.4 MHz IIR
C_FILTER	int	Lowpass filter used for the C component.	filter <sup>1</sup>	none
COMPOSITE_FILTER	int	Lowpass filter used for the Composite signal.	filter <sup>1</sup>	none
SECAM_BOTTLE_SHAPE_SIGNAL	int	Enables the bottle shape signals (SECAM only)	Disable/Enabled	1 (enabled)
U or Q Gain	Double*	Gain applied to the U or the Q signal	none	1.00
V or I Gain	Double*	Gain applied to the V or the I signal	none	1.00
<sup>1</sup> See Appendix C, <i>How the NI 5431 Generates Video Signals</i>				

Figure A-1 shows the relationship between the sync and burst timings and the attribute name. For example, the number 3 in Figure A-1 is specified by the attribute **Sync Duration (us)**.



**Figure A-1.** Relationship between Burst and Sync Timings and the Attribute Name

## Video Signal Fundamentals

This appendix describes the fundamental video signal concepts including the components that make up a composite video signal, the significance of the different video formats, scanning and active imaging, color coding, and video levels.

### Introduction

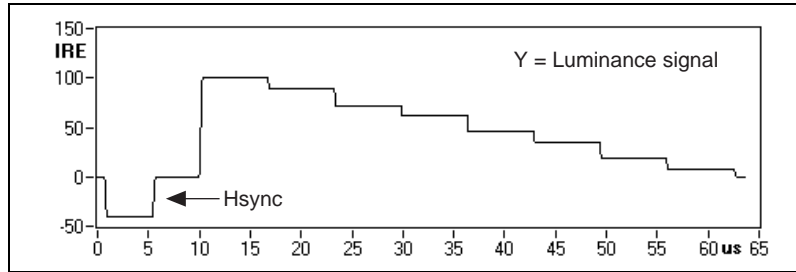
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The NI 5431 is a video generator system designed to generate analog composite video signals. A composite video signal is a signal in which all the components needed to generate a video signal are embedded in a single signal. The three main components that together form a composite signal are as follows:

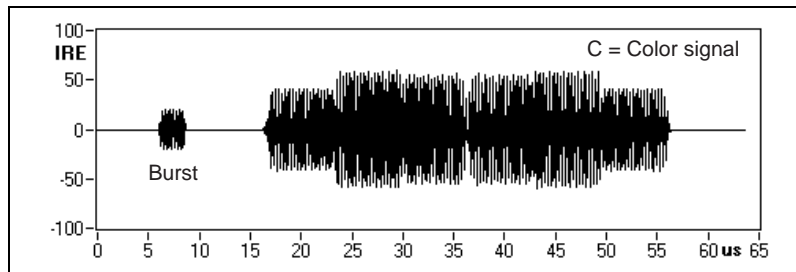
- The luma signal, which is the signal that contains the intensity (brightness or darkness) information of the video image
- The chroma signal, which is the signal that contains the color information of the video image
- The synchronization signal, which is used to control the scanning of the signal on a display such as the TV screen

The composite signal was originally developed by the TV industry as a monochrome signal, which displayed a black and white image. The chroma signal was added later, when color TV was introduced in the 1950s.

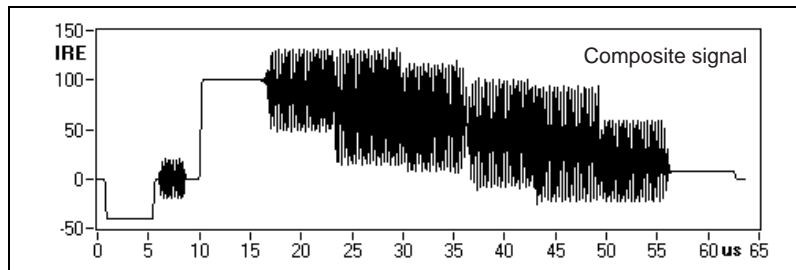
Therefore, the monochrome composite signal is built of two components: luma (or luminance) and synchronization. This signal is usually called the Y signal as shown in Figure B-1. The chroma signal by itself is usually called the C signal as shown in Figure B-2.



**Figure B-1.** Example of Monochrome Composite Video Signal (Luma Steps from White to Black)



**Figure B-2.** Color Information Signal for a Color Bar Line (Including the Color Burst)



**Figure B-3.** Color Composite Video Signal for a Color Bar Line

The composite color video signal, often called the Color Video, Blank, and Sync (CVBS) signal, is the sum of Y and C as shown in Figure B-3.

$$CVBS = Y + C$$

The two components Y and C can also be distributed separately as two independent signals. These two signals together are called either Y/C or S-Video.

$$Y/C = S\text{-Video}$$

## Different Video Formats

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The definition of the composite video signal differs from country to country. There are three main video formats in the world:

- M-NTSC, which is used mainly in the USA and Japan
- B/G-PAL, which is used in most of Europe, parts of Africa, and some other countries such as Australia
- SECAM, which is used in France, the former Soviet Union, and parts of the Middle East

Three other formats, which are M-PAL, N-PAL, and Combination N-PAL, are used in some countries in South America.

## Scanning Speed

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The scanning speed is the number of video frames generated per second. The scanning speed and the number of lines per frame depend on the video format. The prefix M in the M-NTSC and M-PAL formats refers to a scanning speed of approximately 30 frames per second and a scanning system of 525 lines per complete frame. All other formats specify a rate of 25 frames per second and 625 lines per frame.

## Color Coding

---

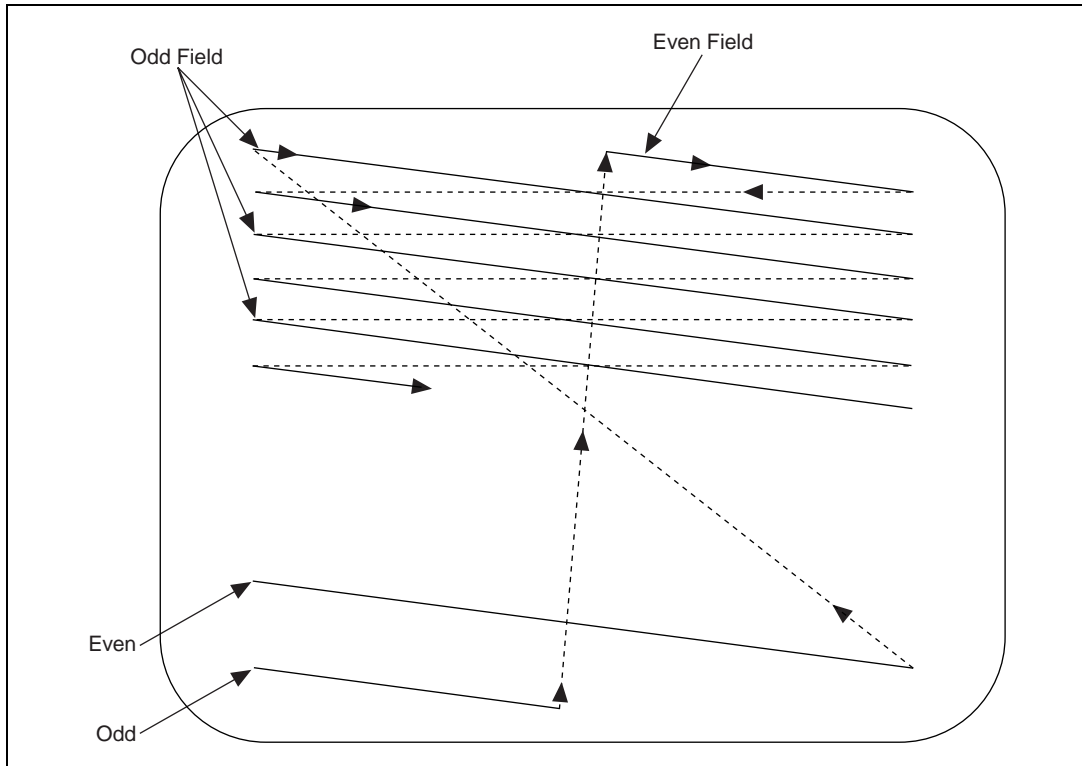
The color information signal C that, together with Y, forms the composite video signal, is a modulated signal. The modulation type depends on the video format.

For all PAL and NTSC formats, the coding is based on the Quadrature Amplitude Modulation (QAM) concept, where two color components are amplitude modulated in quadrature and added together. The modulation needs to be decoded, so to keep track of the absolute phase needed to decode the color information, a reference signal called the color burst is inserted at the beginning of each line, right after the horizontal synchronization pulse as shown in Figure B-3.

For the SECAM format, the two color components are frequency modulated using two different subcarrier frequencies and are distributed sequentially on alternated video lines. There is no need for a color burst signal in SECAM.

# Interlaced Scanning

All composite video systems display the video image on a TV-screen using an interlaced scanning technique. The interlaced scanning concept is shown in Figure B-4.



**Figure B-4.** Interlaced Scanning of the Composite Video Signal

The analog video signal includes synchronization pulses that control the scanning line-by-line from left to right and field-by-field from top to bottom. The pulses that control the line-by-line scanning are called the horizontal synchronization pulses (Hsync) while the pulses that control the vertical scanning are called the vertical synchronization pulses (Vsync).

A complete frame is composed of two interlaced fields. The first field, called the odd field, is scanning the odd lines of the video image. The second field, called the even field, is scanning the even lines of the video image. The process repeats for every frame, which is one odd and one even field.

Figure B-5 shows the result of the scanning of all the 525 lines that compose a complete NTSC frame. The image is simulating the video display that would appear on a television screen if the following conditions were true:

- The television was able to show the entire line instead of just the active image part; see the *Active Image* section for a detailed explanation
- The television was not interlacing the two fields to form a complete image frame, but was displaying a progressive scanning, line by line of the entire frame

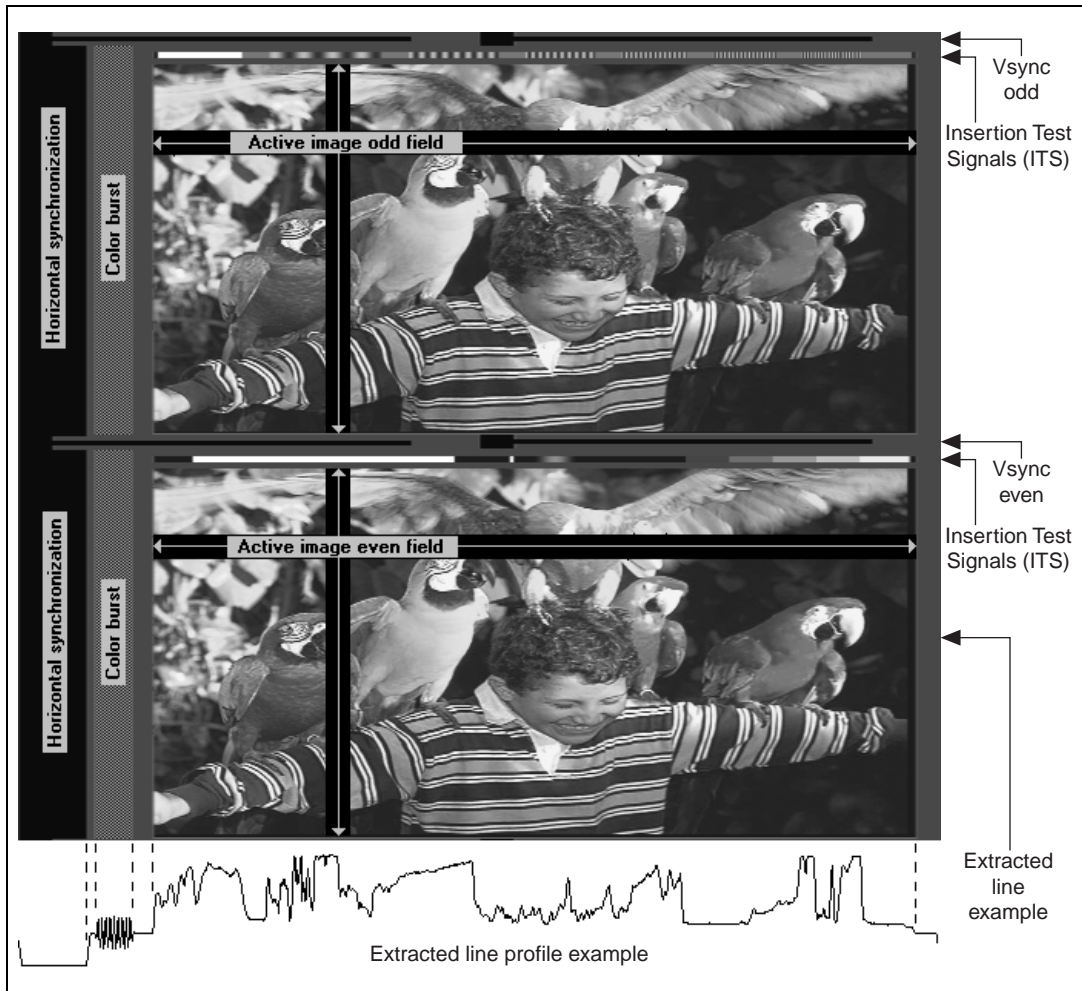
The scanning starts (line by line from top to bottom) with a number of lines that represent the vertical synchronization pattern for the odd field as shown on Figure B-6. Immediately after the vertical synchronization pattern for the odd field, optional insertion test signals (ITS) are inserted. Finally, the actual odd field active image is displayed.

The process repeats for the even field, thus forming the complete frame.



**Note** Most lines start with a horizontal synchronization pulse followed by the color burst pattern. Then the active image (or the ITS) is displayed as an intensity change, where a higher signal level corresponds to brighter intensity.

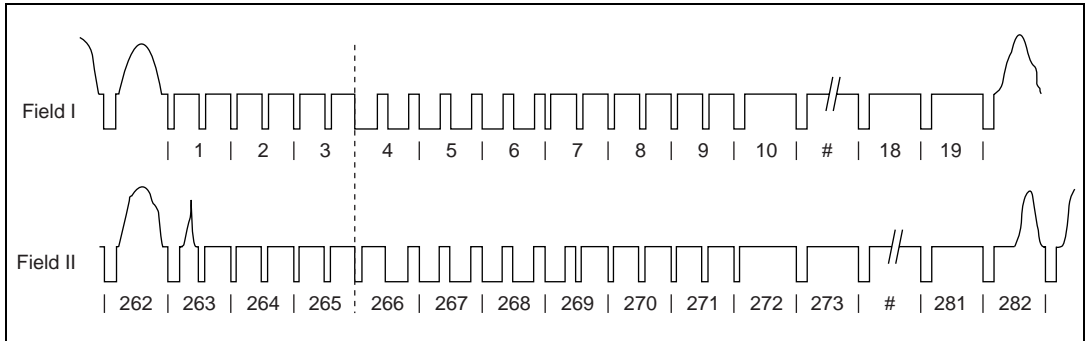
The *Extracted line profile example* at the bottom shows an actual video signal line extracted from the even field. See Figure B-8 and Table B-2 for details on the different video levels.



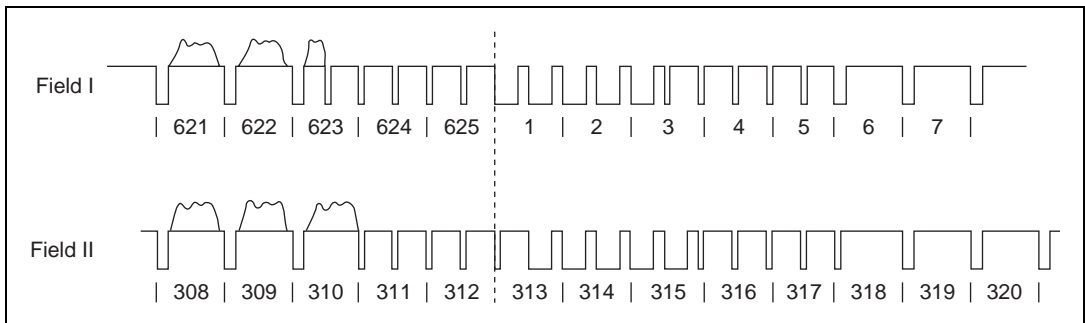
**Figure B-5.** Gray Scale Image and Extracted Line Profile

While the horizontal synchronization pulses are basically simple negative pulses, which are pulses going below the level of the luminance signal, the vertical synchronization signals are composed of pulse trains distributed on several lines and are different for odd and even fields. Figure B-6 and Figure B-7 show the vertical synchronization patterns for both fields and for the three main video formats.





**Figure B-6.** Vertical Blanking and Synchronization Signal for NTSC



**Figure B-7.** Vertical Blanking and Synchronization Signal for PAL and SECAM

## Active Image

The active video image resulting from the scanning always has an aspect ratio (horizontal/vertical) of 4/3, independent of the video format.

As shown in Figure B-5, the scanning process requires some additional room on the left and right sides of each line as well as on the top and bottom of the active video image region. This additional room includes the synchronization signals, color bursts, and other format-specific information, like the insertion test signals (ITS), which are not part of the active video image. Only approximately 90% of all the lines and 80% of each line can be used to transmit the active image information. The exact values depend on the video format and are shown in Table B-1.

*Active Lines* represents the number of lines that are actually used to transmit the image information. For example, only 480 lines out of 525 *Lines/Frame* transmit the image information in NTSC. Likewise, on each

line, the image information is transmitted only during the *Active Lines* part, which is shorter than the entire *Line Duration*. For example, only 52.2  $\mu\text{s}$  are the active lines part out of 63.55  $\mu\text{s}$  line duration in NTSC. *Frame rate* is the scanning speed described in the *Scanning Speed* section.

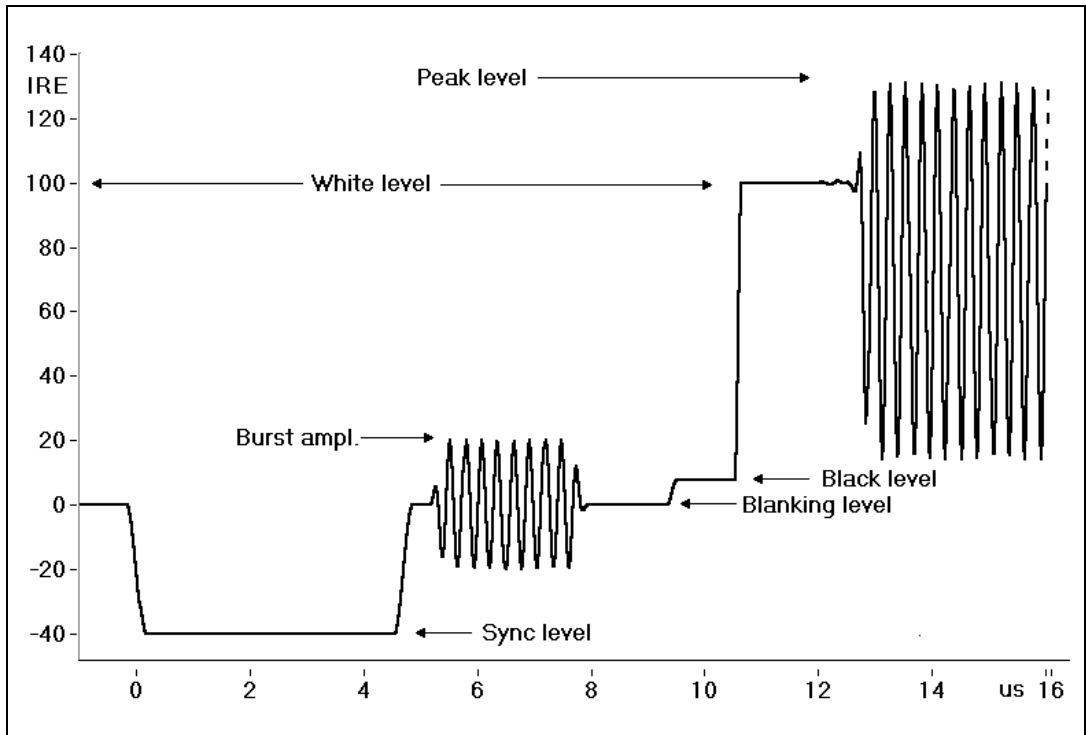
**Table B-1.** Basic Frame Size and Timing

Video Format	Lines/ Frame	Active Lines	Frame Rate	Line Duration	Active Line Duration
M-NTSC/ M-PAL	525	480/ 486	29.97	63.55 $\mu\text{s}$	52.2 $\mu\text{s}$
All others	625	576	25.00	64.00 $\mu\text{s}$	52.0 $\mu\text{s}$

## Video Levels

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The video levels define the levels and ranges for the different parts of the video signal. The unit used to define video levels is the IRE (Institute of Radio Engineers). The blanking level refers to 0 IRE and the white level refers to +100 IRE. The blanking level, which is the reference level for the video signal (usually 0 V), is different from the black level if a setup is applied to the signal as shown in Figure B-8. For the three video formats M-NTSC, M-PAL and N-PAL, a setup of 7.5 IRE is usually applied, moving the black level to +7.5 IRE. For all other formats, the black level is aligned with the blanking level at 0 IRE.



**Figure B-8.** Beginning of a Typical Composite Video Line (NTSC)

Table B-2 shows the different video levels depending on the video format.

**Table B-2.** Video Levels for the Different Video Formats

Video Format	Sync Level	Blanking Level	Black Level	White Level	Peak Level	Burst Amplitude
M-NTSC	-40 IRE	0 IRE	+7.5 IRE	+100 IRE	+120 IRE	20.0 IRE
B/G-PAL	-43 IRE	0 IRE	0 IRE	+100 IRE	+133 IRE	21.5 IRE
SECAM	-43 IRE	0 IRE	0 IRE	+100 IRE	+130 IRE	N/A
M-PAL	-40 IRE	0 IRE	+7.5 IRE	+100 IRE	+120 IRE	20.0 IRE
N-PAL	-40 IRE	0 IRE	+7.5 IRE	+100 IRE	+133 IRE	20.0 IRE
Comb. N-PAL	-43 IRE	0 IRE	0 IRE	+100 IRE	+133 IRE	21.5 IRE

The analog composite video signal is defined as a voltage source with an output impedance of  $75\ \Omega$ . The sync-to-white level is normally 1 V peak-to-peak (Vpp) when loaded with a  $75\ \Omega$  resistance. (Therefore, the unloaded signal is nominally 2 Vpp.)

For NTSC, the difference between white and sync levels is 140 IRE so the analog level corresponds to approximately 7.143 mV/IRE. For B/G-PAL or SECAM, the difference between white and sync levels is 143 IRE so the analog level corresponds to approximately 7.000 mV/IRE.



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# How the NI 5431 Generates Video Signals

This appendix explains how the NI 5431 generates video signals and how the Video Software Toolkit filters video components while computing a video signal.

The NI 5431 board generates an analog video signal by converting a data array from digital to analog. It then downloads this digital data array to the NI 5431 onboard memory. The resolution of the data is 16-bit, even though only 12 bits are being used to represent the analog signal (12-bit digital-to-analog (D/A) converter).

The update rate of the D/A converter depends on the video format as shown in Table C-1.

**Table C-1.** NI 5431 Timing Information

Video Format	Data Rate (MHz)	Total Samples/Line	Active Image Samples/Line	Total Line Duration	Active Line Duration
M-NTSC/ M-PAL	20.013986	1272	1044	63.556 $\mu$ s	52.16 $\mu$ s
All others	20.000000	1280	1040	64.000 $\mu$ s	52.00 $\mu$ s

When a bitmap image is converted to a video signal, the image pixels are extracted line-by-line, and the composite video signal is calculated based on the image pixel values. However, a normal bitmap image with an aspect ratio of 4:3 includes fewer pixels than needed to map, one-by-one, the calculated samples of a video line. For example, in M-NTSC, a typical bitmap image size is  $640 \times 480$ , which is 480 lines of 640 pixels ( $640 = 480 * 4 / 3$ ) as shown in Table C-1. But the number of active image samples per line in the final video signal is 1044 as shown in Table C-1.

To calculate 1044 active video samples based on 640 image pixels, the software interpolates the image data using a linear interpolation algorithm. While this interpolation has very little visible effect on the resulting composite video image, it is still measurable. Therefore, if the active image

is used to perform precision measurements, an input bitmap image of exactly  $1044 \times 480$  is required. Table C-2 shows the different image size values to use depending on the actual video format.

**Table C-2.** Active Image Specifications for the Different Video Formats

Video Format	Total Active Lines	Square Pixels per Line	Active Video Samples/Line	Interpolation Ratio	Active Line Duration
M-NTSC/ M-PAL	480/ 486	640	1044	1.63125	52.16 $\mu$ s
All other formats	576	768	1040	1.35417	52.00 $\mu$ s

In the BMPs directory, different full-precision bitmap images can be found in the  $1044 \times 480$  folder (to be used with M-NTSC or M-PAL formats) or the  $1040 \times 576$  folder (to be used with all other formats).

The same considerations are made for the use of Insertion Test Signals (ITS). To keep the full accuracy (avoiding automatic interpolation) of a test signal inserted in the image, such as the vertical blanking interval shown in Figure B-5, *Gray Scale Image and Extracted Line Profile*, you must make sure that the used test line data arrays have the correct length (1044 samples for M-NTSC and M-PAL, and 1040 samples for all other formats).

## How the Video Software Toolkit Filters Video Components

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The Video Software Toolkit has many ways to filter different video components while computing a video signal. Video formats (PAL, NTSC, or SECAM) require some of these filters, while some are optional. There are three modes you can use to filter:

- Use one or more of the predefined Finite Impulse Response (FIR) filters.
- Use one or more of the predefined Infinite Impulse Response (IIR) filters.
- Use one or more user-defined FIR or IIR filters. See the *Create Many Lines Using ITS and Apply User-Defined Filters* section in Chapter 2, *Introductory LabVIEW Programming Examples*.

All predefined filters are designed so they have no group delay across the entire frequency range. In other words, there is no phase error and no delay between any part of the different signal components, whether these components are filtered or not.



**Note** The IIR filters are not classical type IIR filters but an advanced version of the IIR filtering with symmetrical impulse response, that is, zero group delay error.

The key difference between an FIR and an IIR filter is whether the impulse response is finite (FIR) or infinite (IIR). FIR filtering is faster in computation than IIR filtering and often has a step response with less overshoot than the equivalent IIR filter. On the other hand, the frequency response of the FIR filters is not as sharp as the corresponding IIR filter.

The use of the FIR or IIR filter type depends on the application. If frequency attenuation is important, the IIR filters are recommended. If fast calculation time is of higher priority, then the FIR filters may be a better choice. If you do not specify anything, the video toolkit software uses default filters that fulfill the different requirements of the video standards.

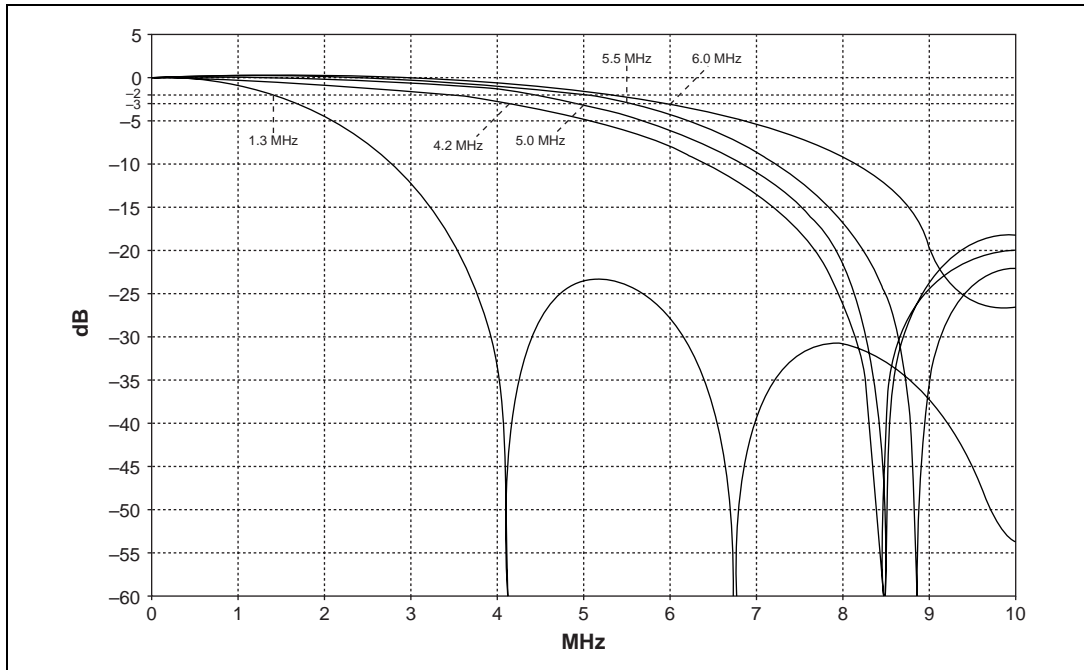
The default filters are as follows:

- For NTSC:
  - Y (luminance component): No filter
  - Q (first chroma component): 0.4 MHz IIR filter
  - I (second chroma component): 1.3 MHz FIR filter
  - Entire composite signal: No filter
- For PAL or SECAM:
  - Y (luminance component): No filter
  - U (first chroma component): 1.3 MHz FIR filter
  - V (second chroma component): 1.3 MHz FIR filter
  - Entire composite signal: No filter

Figures C-1 and C-2 show the frequency response for all the predefined FIR and IIR video filters. The filter specifications are given in Table C-3.

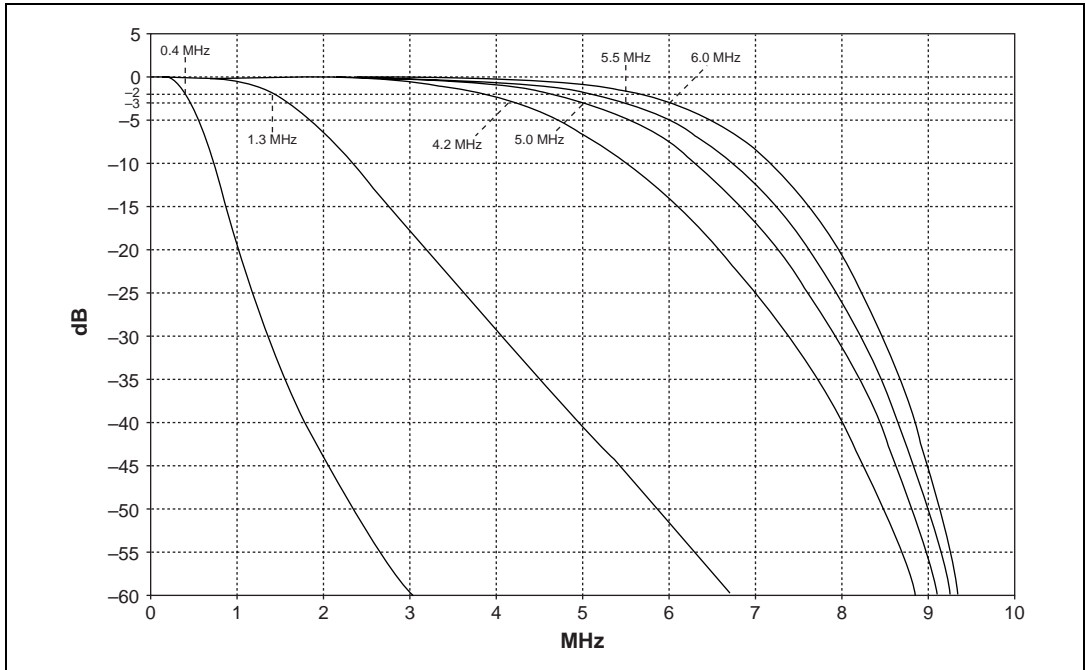
**Table C-3.** Filter Specifications

Filter Cut-off	Designed for Filtering	Filter Type	Attenuation at Cut-off	Stop Band Frequency	Attenuation in Stopband
0.4 MHz	Q component	IIR only	< 2 dB	0.6 MHz	> 6 dB
1.3 MHz	I / U / V component	FIR / IIR	< 2 dB	3.6 MHz	> 20 dB
4.2 MHz	M-NTSC signal	FIR / IIR	3 dB	See Figures C-1 and C-2	See Figures C-1 and C-2
5.0 MHz	B/G-PAL signal	FIR / IIR	3 dB	See Figures C-1 and C-2	See Figures C-1 and C-2
5.5 MHz	I-PAL signal	FIR / IIR	3 dB	See Figures C-1 and C-2	See Figures C-1 and C-2
6.0 MHz	D-PAL signal	FIR / IIR	3 dB	See Figures C-1 and C-2	See Figures C-1 and C-2



**Figure C-1.** Frequency Response for the Different Predefined FIR Filters





**Figure C-2.** Frequency Response for the Different Predefined IIR Filters

# System Specifications

This appendix lists the video specifications for the NI 5431.

## Analog Specifications

Output impedance .....	75 $\Omega$
Output level in 75 $\Omega$ load.....	7 mV/IRE (Nominal or 1 V) sync-to-white 35 mV/IRE (max)
Output level resolution.....	0.01%
DC coupled output with 0 V at Sync-tip or blanking	
Frequency response.....	DC to 8 MHz $\pm$ 0.1 dB
Dynamic range .....	>60 dB
Harmonic distortion .....	<0.1% at 1 MHz
Differential amplitude linearity error (4 MHz).....	<0.5%
Differential phase linearity error (4 MHz).....	<0.5 deg

## Standard Test Picture Library (BMP)

Color bars type .....	100/0/100/0, 100/0/75/0 75/0/75/0, 75/25/75/25 (7.5% setup disabled)
Black, 50% gray, white, red, green, or blue frame	
White grid and circle (geometry and convergence)	
Overscan/underscan markers	

## Standard Waveform Library (Binary Data)

M-NTSC .....	SMPTE picture, Multiburst frame, Composite NTC-7, Grayscale steps, Vertical moving bars, Diagonal moving bars
B/G-PAL.....	Philips standard test pattern, 100/0/75/0 color bars, Multiburst frame, Vertical moving bars, Diagonal moving bars

## Insertion Test Signals (ITS)

You can insert full-accuracy test signals either in the vertical blanking interval (VBI) or anywhere in the active range region. These signals are defined as  $3 \times 16$  bit arrays representing either RGB or YUV (resp. YQI) information. For SECAM, you can disable the FM subcarrier for generation of the Y signal only.

B/G-PAL.....	Standard color bars, 5 and 10 step staircase, Modulated ramp, Modulated staircase, Modulated pedestal, Multiburst, ITU composite test signal, ITU combination test signal, Sin(x)/x pulse, Frequency sweep, Multitone
M-NTSC .....	Standard color bars, 5 and 10 step staircase, Modulated ramp, Modulated staircase, Modulated pedestal, Multiburst, Multipulse, NTC-7 composite test signal, NTC-7 combination test signal, Sin(x)/x pulse, Frequency sweep, Multitone

## Adjustable Video Attributes

Sync Parameters .....	Rise/fall time, width, and amplitude
Color Burst Parameters .....	Rise/fall time, start position, width and amplitude, absolute phase
Luma Controls.....	Brightness, contrast, setup, gamma correction
Chroma Controls .....	Saturation, Chroma Phase, independent U&V or Q&I gains
Active Image Formatting .....	Horizontal position, width, and stretch; Vertical position and height
Filters .....	Independent selectable (standard or custom) filters on the following components: Y, U&V, Q, I, C and composite signal
Miscellaneous.....	You can add optional white noise to the composite signal. You can add optional second or third harmonic distortion to the Chroma signal.

## Digital Sync Output

You can use four digital TTL output lines to generate the following synchronization signals:

Synchronization signals .....	Composite signal, Horizontal sync, Vertical sync, Field identification
-------------------------------	--

## Genlocking of Multiple Boards

Synchronize multiple NI 5431 boards (using the RTSI bus or PXI trigger bus) for generation of several composite (genlocked), Y/C (S-Video), or RGB video signals. Generation of Y/C and RGB signal requires respectively two and three NI 5431 boards.

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# Technical Support Resources

This appendix describes the comprehensive resources available to you in the Technical Support section of the National Instruments Web site and provides technical support telephone numbers for you to use if you have trouble connecting to our Web site or if you do not have internet access.

## NI Web Support

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To provide you with immediate answers and solutions 24 hours a day, 365 days a year, National Instruments maintains extensive online technical support resources. They are available to you at no cost, are updated daily, and can be found in the Technical Support section of our Web site at [www.ni.com/support](http://www.ni.com/support)

### Online Problem-Solving and Diagnostic Resources

- **KnowledgeBase**—A searchable database containing thousands of frequently asked questions (FAQs) and their corresponding answers or solutions, including special sections devoted to our newest products. The database is updated daily in response to new customer experiences and feedback.
- **Troubleshooting Wizards**—Step-by-step guides lead you through common problems and answer questions about our entire product line. Wizards include screen shots that illustrate the steps being described and provide detailed information ranging from simple getting started instructions to advanced topics.
- **Product Manuals**—A comprehensive, searchable library of the latest editions of National Instruments hardware and software product manuals.
- **Hardware Reference Database**—A searchable database containing brief hardware descriptions, mechanical drawings, and helpful images of jumper settings and connector pinouts.
- **Application Notes**—A library with more than 100 short papers addressing specific topics such as creating and calling DLLs, developing your own instrument driver software, and porting applications between platforms and operating systems.

## Software-Related Resources

- **Instrument Driver Network**—A library with hundreds of instrument drivers for control of standalone instruments via GPIB, VXI, or serial interfaces. You also can submit a request for a particular instrument driver if it does not already appear in the library.
- **Example Programs Database**—A database with numerous, non-shipping example programs for National Instruments programming environments. You can use them to complement the example programs that are already included with National Instruments products.
- **Software Library**—A library with updates and patches to application software, links to the latest versions of driver software for National Instruments hardware products, and utility routines.

## Worldwide Support

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National Instruments has offices located around the globe. Many branch offices maintain a Web site to provide information on local services. You can access these Web sites from [www.ni.com/worldwide](http://www.ni.com/worldwide)

If you have trouble connecting to our Web site, please contact your local National Instruments office or the source from which you purchased your National Instruments product(s) to obtain support.

For telephone support in the United States, dial 512 795 8248. For telephone support outside the United States, contact your local branch office:

Australia 03 9879 5166, Austria 0662 45 79 90 0, Belgium 02 757 00 20,  
Brazil 011 284 5011, Canada (Calgary) 403 274 9391,  
Canada (Ontario) 905 785 0085, Canada (Québec) 514 694 8521,  
China 0755 3904939, Denmark 45 76 26 00, Finland 09 725 725 11,  
France 01 48 14 24 24, Germany 089 741 31 30, Greece 30 1 42 96 427,  
Hong Kong 2645 3186, India 91805275406, Israel 03 6120092,  
Italy 02 413091, Japan 03 5472 2970, Korea 02 596 7456,  
Mexico (D.F.) 5 280 7625, Mexico (Monterrey) 8 357 7695,  
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Singapore 2265886, Spain 91 640 0085, Sweden 08 587 895 00,  
Switzerland 056 200 51 51, Taiwan 02 2528 7227,  
United Kingdom 01635 523545

# Glossary

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Prefix	Meaning	Value
μ-	micro-	10 <sup>-6</sup>
m-	milli-	10 <sup>-3</sup>
k-	kilo-	10 <sup>3</sup>
M-	mega-	10 <sup>6</sup>

## Numbers/Symbols

### A

active video	the part of the video waveform that is not specified to be blanking, burst, or sync information. Most of active video is visible on the display screen.
amplitude modulated	a signal coding form where the information signal modulates the amplitude of a tone called the subcarrier
array	ordered, indexed list of data elements of the same type
attenuation	decreasing the amplitude of the signal
attribute	programmer's name for the video parameters that you can modify using the <code>NI-VDG.dll</code> . Also includes parameters such as output level, which is a board attribute. See <a href="#">parameters</a>

### B

<code>.bin</code>	file extension for a binary file. See <a href="#">binary file</a>
binary file	16-bit file format used to save the data of a complete composite video signal. See <a href="#">.bin</a>
bitmap image	RGB image format. See <a href="#">.bmp</a>

black burst	a composite video signal with a totally black picture. It is used to sync video equipment together so that video output is aligned. It tells the video equipment the vertical and horizontal sync and the chroma burst information.
black level	this level represents the darkest an image gets and defines black for an image system. If the video drops below this level, it is called blacker-than-black.
blanking	occurs when the scan line moves from the left to the right edge of the screen, then jumps back to the left edge, and starts over down the screen. The video signal is blanked when the scan line hits the right-hand limit so that you cannot see the return path of the scan beam from the right to the left-hand edge of the screen.
block mode	optimized calculation mode where a block of video lines is computed simultaneously
.bmp	file extension on a bitmap image. See <i>bitmap image</i>
brightness	the intensity of the video level; how much light is emitted by the display. Also the attribute that allows you to add a constant luminance level to the active video signal
burst	see <i>color burst</i>
<b>C</b>	
.cfg	file extension on a configuration file. See <i>configuration file</i>
chroma	the color part of the composite video signal
color burst	portion of the video waveform that sits between the horizontal synchronization pulse and the start of the active video. Color burst tells the color decoder the absolute phase reference needed to correctly decode PAL or NTSC signals.
color burst start	position on the video line where the rising color burst signal passes 50% of its final amplitude
color burst width	duration of the color burst signal measured between its 50% rising and 50% falling amplitude



color coding	the coding format used to include the color information in the composite video signal. The three most common coding formats are: Standard Pal, NTSC, and SECAM.
color space	a mathematical representation for a color. There are different color spaces such as RGB, YIQ, and YUV, which represent colors based on different coordinate systems.
combination N-PAL	video format used in Argentina
composite filter	filter applied to the entire composite video signal
composite video signal	a single signal that contains luma, chroma, and synchronization information
configuration file	a file where you can save your specific video signal setup conditions such as the video parameters or attributes, video format, and some other information regarding the signal
contrast factor	in a video waveform, the distance between the whitest whites from the blackest blacks. Also the attribute that allows you to apply a gain factor to the active video signal.
Csync	composite synchronization signal; a single signal including both horizontal and vertical synchronization pulses

## D

digital synchronization	digital TTL signals delivering Csync, Vsync, Hsync and field ID signals on the digital connector of the NI 5431 board
-------------------------	---

## F

field ID	the field ID signal identifies the even or odd field in an interlaced video frame
filter coefficients	constant values that characterize a digital filter
filter cut-off	the frequency up to what the filter lets the signal pass through
filters	digital or analog circuits that change the frequency characteristics of a video signal

FIR filter	Finite Impulse Response filter. This is a type of digital filter that can be lowpass, highpass, or bandpass. Non-recursive filter type
frequency modulated	a signal coding form where the information signal modulates the frequency of a tone called the subcarrier
frequency modulation subcarrier	carrier signal in SECAM used to represent the chroma information

## G

gain	the factor by which a signal is amplified, sometimes expressed in decibels. A gain of 2 corresponds to a doubling of the signal level.
------	--

## H

harmonic	a component frequency of a wave that is an integral multiple of the fundamental frequency
horizontal sync pulse	tells the receiving system where the beginning of the new scan line is. See <a href="#">Hsync</a>
Hsync	horizontal sync; the portion of the video signal that tells the display where to place the image in the left-to-right dimension. See <a href="#">horizontal sync pulse</a>

## I

IIR filter	Infinite Impulse Response filter
image duration	the time duration of the active image in a video line
image start line	the line in the composite video signal where the first active video line is located
image start position	the position on a line, right after the color burst, where the active image part of the line starts
insertion test signals	test signals to be inserted on specific lines either in the vertical blanking interval or in the active image region
interlaced scanning	a scanning technique used by all composite video systems to display the video image.

**IRE** Institute of Radio Engineers; an arbitrary unit used to describe the level of a video signal. Pure white is defined as 100 IRE. The blanking level is defined as 0 IRE.

**ITS** Insertion Test Signals

## L

**line-by-line mode** calculation mode where the video lines are computed one at a time

**line rate** how many lines are generated per second. The line rate is the product of the scanning speed by the number of lines per frame. See [scanning speed](#)

**low-level driver VI** the lowest level of programming. The low-level driver VI offers most functionality but requires more programming.

**lowpass filter** a circuit used to smooth the video signal output and remove unwanted high frequency contents from the signal

**luma** the monochrome part of the composite video signal. See [luminance](#)

**luminance** see [luma](#)

## M

**maps** a bitmap image needs to be mapped by the software before it is used to compute a composite video signal

**modulation cosine** cosine function representing the subcarrier for the second chroma component in PAL or NTSC systems

**modulation sine** sine function representing the subcarrier for the first chroma component in PAL or NTSC systems

**monochrome** grayscale; no color

**M-NTSC** see [NTSC \(M-NTSC\)](#)

**M-PAL** video standard used in Brazil. Uses 525 lines per frame (M) but PAL color coding

## N

NI 5431	video generator system based on the National Instruments PCI 5431 or the PXI 5431 board
noise level (IRE)	the level of noise that may appear on the video signal
N-PAL	video standard used in Uruguay and Paraguay. Uses 625 lines per frame
NTSC (M-NTSC)	National Television Standards Committee; the video standard used in North American and Japan. Uses 525 lines per frame

## O

offset	constant value added to a signal
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## P

PAL	Phase Alternation Line; color video standard used in Europe and in many other countries outside the U.S. M-PAL uses 525 lines per frame. All other PAL formats use 625 lines per frame.
parameters	non-programmer's term for video signal conditions that you can modify using the NI-VDG.dll. See <i>attribute</i>
PCI 5431	the hardware board for PCI bus used in the NI 5431 video generator system
peak level	the maximum level that can occur in a signal
prepare mode	mode to be called before lines calculation in block mode
PXI 5431	the hardware board for PXI bus used in the NI 5431 video generator system

## R

release mode	mode to be called after lines calculation in block mode
resolution	the smallest signal increment that can be detected by a measurement system. Resolution can be expressed in bits, in proportions, or in percent of full scale. For example, a system has 12-bit resolution, one part in 4,096 resolution, and 0.0244 percent of full scale.

RGB	red, green, blue
RGB ITS	ITS type based on three data arrays (R, G, and B) of unsigned 16-bit data (U16)

## S

saturation factor	the amount of color pigment present. The less saturated a color is, the more white will be present in the color. Also the attribute that allows you to apply a gain factor to the chroma signal.
scaling	the act of changing the effective resolution of an image
scan line	an individual sweep across the face of the display by the electron beam that makes the picture. It takes 525 scan lines to make up a NTSC TV frame.
scanning speed	how many frames are generated per second. See <a href="#">line rate</a>
SECAM	Sequentiel Couleur Avec Memoire or Sequential Color with Memory. Video standard used in France and parts of Africa and Middle East. Uses 625 lines per frame. In SECAM, the chroma is FM modulated and the R'-Y and B'-Y signals are transmitted line sequentially.
settings	video signal conditions, which are also known as video <a href="#">parameters</a> or <a href="#">attributes</a>
setup level (IRE)	an offset level, usually 7.5 IRE, that is moving the black level above the blanking level in certain video formats like NTSC, M-PAL, and N-PAL
SGL	single precision
standard PAL	a common denomination for the PAL standards that share the same baseband specifications. These include B, D, G, H, and I-PAL.
subcarrier	a signal with well-defined amplitude, frequency, and phase that is modulated (either in amplitude or in frequency) by the color information and results in the composite chroma component.
subcarrier reference phase	a reference value specifying the absolute phase of the subcarrier
S-Video	see <a href="#">Y/C</a>

sync	synchronization signals controlling the horizontal and vertical deflections in a TV.
sync amplitude (IRE)	the level of the synchronization pulses
sync rise/fall time (us)	the rise or fall time measured from 10% to 90% of the synchronization pulses
sync width	the duration (50% to 50%) of the synchronization pulses

## T

tint correction (degrees)	an angle value that rotates the color plane allowing, in NTSC, to correct for small errors
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TTL	transistor-transistor logic
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## U

unmaps	the bitmap image is unmapped after being used to compute a composite video signal
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## V

VBI	vertical banking interval
vertical sync pulses	pulses that control the vertical scanning. See <a href="#">Vsync</a>
video attribute	a parameter of a video signal
video data file	file containing the binary data that represent a video signal
video format	specifies the video norm used to compute the video signal such as M-NTSC or SECAM
video level	the level in the video signal which, as an example, defines the range of brightness or darkness in the image on the video display screen
video lines	the lines that compose a video signal

Video Software Toolkit	the software package from your installation CD, which takes care of the needed calculations and driver functions especially developed to interface between your computer and your NI 5431
video waveform	what the signal looks like to the video output device
VITS	Vertical Insertion Test Signals
Vsync	vertical sync; the portion of the video signal that tells the display where to place the image in the top-to-bottom dimension. See <a href="#">vertical sync pulses</a>

## W

white level	a video signal level that represents the lightest an image gets and defines white for an image system (usually 100 IRE)
-------------	---

## Y

Y	luma and sync components in a composite video signal. See <a href="#">S-Video</a> or <a href="#">Y/C</a>
Y/C	video signal where the luma signal Y and the chroma signal C are distributed independently
YIQ	the color space used in the M-NTSC color system. Y represents the luma component while I and Q represent the unmodulated color difference components placed over the luma component.
YUV	the color space used by the PAL or NTSC color system. Y is the luma component while U and V are the color difference components.

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