User Manual

Tektronix

TSG 601
Serial Digital Generator

070-8910-03

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General Safety Summary

Review the following safety precautions to avoid injury and prevent damage to this product or any products connected to it. To avoid potential hazards, use this product only as specified.

Only qualified personnel should perform service procedures.

To Avoid Fire or Personal Injury

Observe All Terminal Ratings. To avoid fire or shock hazard, observe all ratings and markings on the product. Consult the product manual for further ratings information before making connections to the product.

The common terminal is at ground potential. Do not connect the common terminal to elevated voltages.

Replace Batteries Properly. Replace batteries only with the proper type and rating specified.

Recharge Batteries Properly. Recharge batteries for the recommended charge cycle only.

Use Proper AC Adapter. Use only the AC adapter specified for this product.

Do Not Operate Without Covers. Do not operate this product with covers or panels removed.

Use Proper Fuse. Use only the fuse type and rating specified for this product.

Do Not Operate With Suspected Failures. If you suspect there is damage to this product, have it inspected by qualified service personnel.

Do Not Operate in Wet/Damp Conditions.

Do Not Operate in an Explosive Atmosphere.

Safety Terms and Symbols

Terms in This Manual. These terms may appear in this manual:

WARNING. *Warning statements identify conditions or practices that could result in injury or loss of life.*

CAUTION. *Caution statements identify conditions or practices that could result in damage to this product or other property.*

Terms on the Product. These terms may appear on the product:

DANGER indicates an injury hazard immediately accessible as you read the marking.

WARNING indicates an injury hazard not immediately accessible as you read the marking.

CAUTION indicates a hazard to property including the product.

Symbols on the Product. These symbols may appear on the product:

CAUTION
Refer to Manual

Double
Insulated

Battery Recycling

This product contains a Nickel Cadmium (NiCd) battery, which must be recycled or disposed of properly. For the location of a local battery recycler in the U.S. or Canada, please contact:

RBRC
Rechargeable Battery Recycling Corp.
P.O. Box 141870
Gainesville, Florida 32614

(800) BATTERY
(800) 227-7379
www.rbrc.com

Getting Started

Please note the following statements before using your TSG 601.

CAUTION. *Attempting to operate the TSG 601 with an improper AC adapter can result in damage to the instrument. To avoid damage, USE ONLY AN APPROPRIATE DC POWER SOURCE: Voltage must be 9 to 15 VDC; the connector must have the NEGATIVE contact in the center; and open-circuit voltage of the power source must not exceed 18 VDC.*

For best results, use the AC adapter that is supplied with the instrument. If the supplied adapter is incorrect for the local AC power supply,

WARNING. *Install or replace batteries only with the instrument switched OFF and the AC adapter disconnected.*

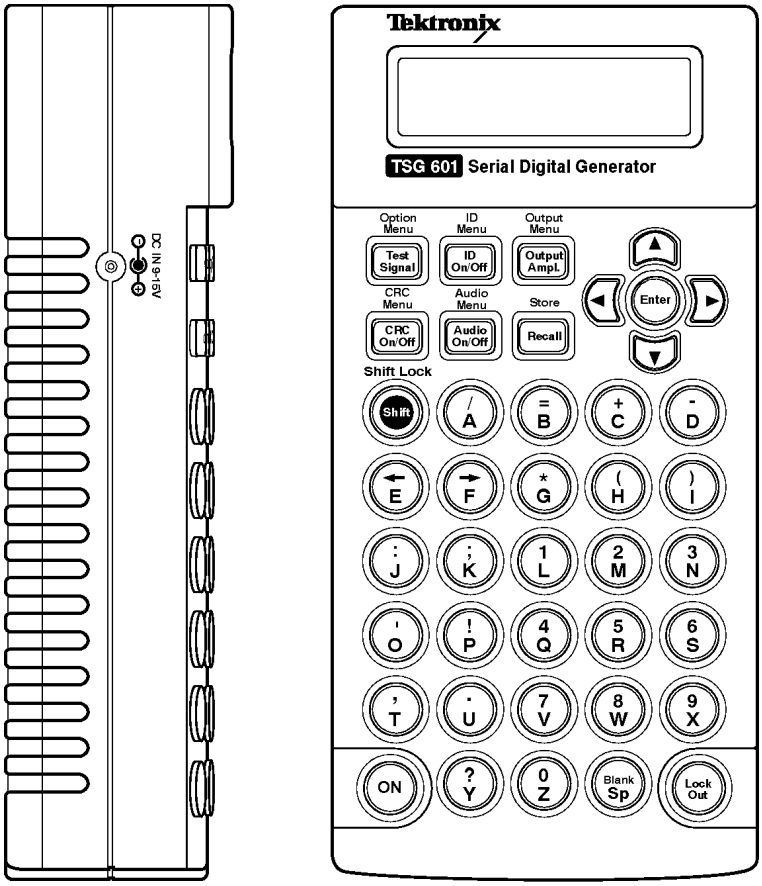
Replace the batteries only with standard AA batteries (1.2–1.5 V, nominal), or with the optional rechargeable battery pack.

If you use NiCad AA batteries or the optional battery pack, be sure to set the battery type to "rechargeable" through the diagnostic menu (see page 56). Failure to do so can result in damage to the batteries.

NOTE*. Do not disconnect the AC adapter when the TSG 601 is switched on. Some user settings may be lost, perhaps causing unexpected results the next time the instrument is switched on.*

Operating Basics

Thank you for choosing the Tektronix TSG 601—and thank you for reading this manual. To begin using the instrument as quickly as possible, see “Using your TSG 601,” beginning on page 5. For even more information on selected topics, turn to “Details,” on page 17. First, though, read the next section for tips on supplying power to the instrument.



Powering the Instrument

The TSG 601 is DC powered. You may power it with the standard AC adapter, the optional 9.6 V NiCad battery pack, eight standard AA batteries, or a “BP” type battery pack with the correct voltage and polarity. The external DC power connector is on the left side of the instrument (see the illustration above). Open the battery compart-

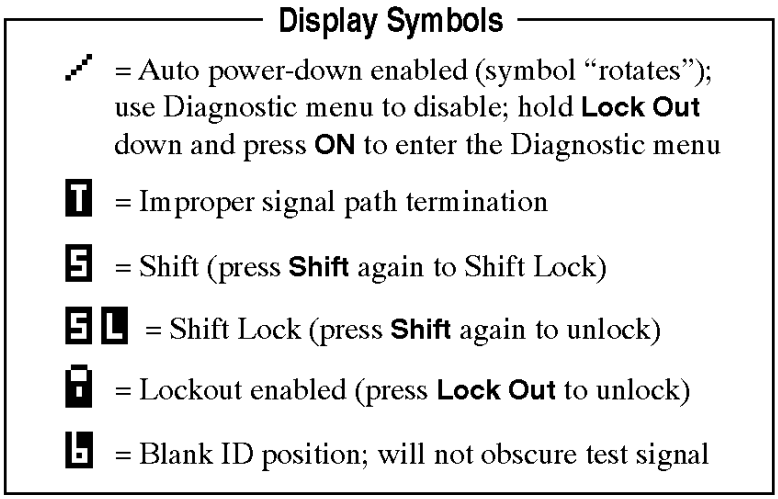
ment by sliding the compartment door in the direction of the inscribed arrow until the door tabs line up with the slots in the case, then remove the door. When selecting a power source for your TSG 601, please remember:

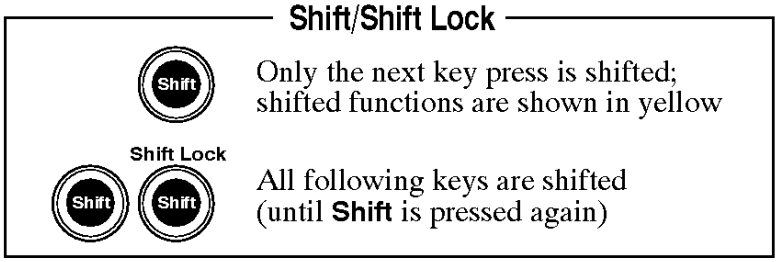
- Attempting to use an improper AC adapter can cause permanent damage to the instrument. USE AN APPROPRIATE DC POWER SOURCE ONLY: Voltage must be between 9 and 15 VDC; the center contact of the connector must be NEGATIVE polarity; and open-circuit voltage must not exceed 18 VDC. For best results, use the adapter supplied with the instrument.
- There is no need to remove the optional NiCad battery pack for recharging. The TSG 601 will "trickle charge" the battery pack whenever the standard AC adapter is used. It can take up to 16 hours to fully charge the battery pack. *Note that charging will occur only if the adapter supplies at least 12 V; make sure that the adapter you use is appropriate for the local AC supply.*
- AA batteries are not included with the instrument; buy them locally. Rechargeable AA batteries may be used, but they are NOT recharged automatically. To recharge AA batteries, remove them from the instrument and use an appropriate battery charger. For safety, read and follow the battery charger instructions. Do NOT attempt to recharge standard alkaline batteries.
- After a minute with no key press, the display back light will be dimmed to conserve battery charge.
- To guard against battery discharge if you forget to turn the TSG 601 off, enable Auto Power Down through the Diagnostic menu (see page 56).
- The TSG 601 can sense low battery voltage. It will warn you when the charge is sufficient for approximately ten more minutes of operation. The instrument will shut itself down when the battery voltage becomes too low for reliable operation. See the Battery hints in Appendix C, beginning on page 55 of this manual.

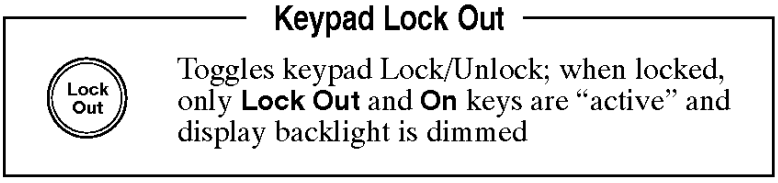
The **ON** key toggles instrument power On and Off.

Keypad and Display Conventions

Please see the Instruction card (p/n 070-8909-00) supplied with your TSG 601 for a “tour” of the keypad and an explanation of the display symbols. For your convenience, the following panels are excerpted from the card.







Using your TSG 601

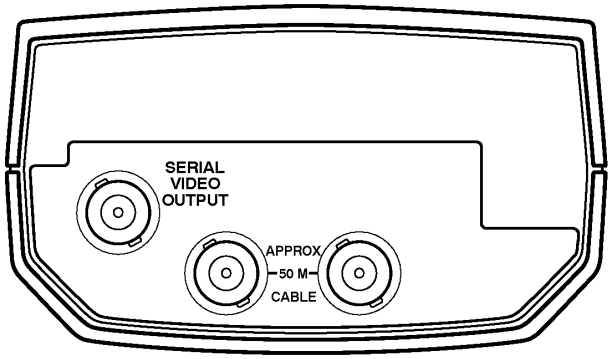
Here’s a list of what you can do with your TSG 601. Simple instructions for each operation begin on the indicated page.

- Output serial video test signals (page 6).

  - Specify the peak–to–peak amplitude of the serial output, from 600 to 1000 mV (page 8).
  - Choose the video components (Y, C_r, C_b) to be included in the serial output (page 8).
  - Specify 8- or 10-bit video sample words (page 9).
- Embed CRC information (used for “Error Detection and Handling,” or EDH) in the output to detect or simulate errors originating in the serial data path (page 9).
- Add an ID message to the video signal, and place it where you want in the picture (pages 10, 11).
- Store up to eight ID messages for later use (pages 10, 16).
- Create a sequence of (up to four) stored ID messages that will cycle continuously in the output (page 11).
- Embed Audio information in the serial video data path (page 12)
- Simulate the effect on your system of 50 m (164 ft.) of coaxial cable (page 15).
- Detect improper termination of the serial video signal path (page 15).
- Save all the current instrument settings as a “Preset” for later recall (page 16).

Outputting Serial Video Test Signals

1. Connect the Serial Video Output of the instrument to your system. Use 75 Ω cable and be sure that the signal path is terminated properly.



2. Power the TSG (page 3) and switch it on. By default, the instrument will begin with most settings that were in effect when it was switched off. Two exceptions: all video component channels will be ON (see page 8); and the output amplitude will be 800 mV.
3. Select the appropriate serial video standard (625/50 or 525/60) through the Diagnostic menu (pages 56, 58).
4. Return to normal operation by pressing the Test Signals key.
5. Select the desired test signal one of three ways:
   - Press the Test Signals key repeatedly until the name of the signal you want appears on the display. The signal will be output as soon as the name is visible. Or...
   - Use the ▲ and ▼ keys to scroll through the list of signals until you get to the desired signal. Or...
   - Press the appropriate letter key (A through P) to “Direct-Select” the signal. The available signals and their corresponding keys are listed below.

Test Signal	Direct-Select Key
75% Color Bars	A
100% Color Bars	B
Pluge 1 (BBC 1)	C
Pluge 2 (BBC 2)	D
5-Step Staircase	E
Limit Ramp	F
Shallow Ramp	G

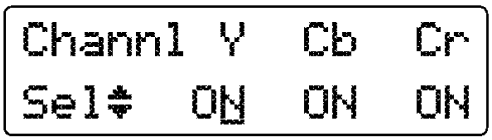
Test Signal	Direct-Select Key
Modulated 5-Step	H
Modulated Pulse and Bar	I
60% Line Sweep with Markers	J
Bowtie	K
Convergence	L
Equalizer SDI Checkfield	M
PLL SDI Checkfield	N
Matrix SDI Checkfield	O
Active Picture Markers	P

Adjusting the Output Amplitude

1. Press the key marked “Output Ampl.”
2. Select the desired output level with the arrow keys. The ▲ / ▼ keys change the level to the next higher or lower 100 mV increment; ◀ / ▶ keys change it in 20 mV increments. Holding an arrow key down will continually increase or decrease the level until it reaches its minimum or maximum.
3. Press any rectangular key to exit the Output Amplitude Adjust function.

Controlling the Video Component (Y, C_r, C_b) Channels

1. Enter the Output menu (press **Shift**, then **Output Ampl.**) and press **ENTER** to reach “Channel Output Selection.” The display will look something like this:



2. Use the ◀ and ▶ keys to position the flashing underline cursor to the status (ON or OFF) of the channel you wish to change.

3. Toggle the status with the ▲ or ▼ key. The channel status will change instantly—you don't have to press **ENTER**.

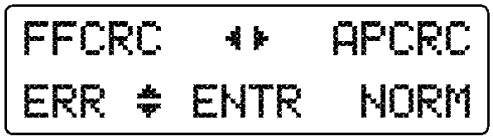
NOTE. *All three component channels default to ON whenever the TSG 601 is switched off and back on, regardless of prior "Channel Output" settings.*

Specifying 8- or 10-bit Data Words

1. If necessary, enter the Output menu (press **Shift**, then **Output Ampl.**).
2. Scroll down to the "Video Data Word Length" item with the down arrow key and press **ENTER** to reach the word length selection display**.**
3. Use the ◀ or ▶ key to toggle between 8 and 10 bits; press **ENTER** to confirm the selection.
4. Press any rectangular key to exit the Output menu.

Specifying CRC Content of the Signal

1. Enter the CRC menu (press **Shift**, then **CRC On/Off**). The display will resemble the following illustration.



2. Use the ◀ / ▶ keys to select FFCRC (Full Field CRC) or APCRC (Active Picture CRC). Notice that the up/down symbol on the second display line will move to indicate the chosen type of CRC.
3. Use the ▲ / ▼ keys to select the type of CRC to be encoded into the output. The choices for the two types of CRCs are:
   - FFCRC — NORM or ERR (Error)
   - APCRC — NORM, ZERO, or ERR (Error)

   See "CRCs" on page 17 for an explanation of these options.

4. Once the desired CRC choices appear on the display, press **ENTER** to accept/invoke the selections.
5. Press any rectangular key to exit the CRC menu.
6. Toggle the inclusion of CRC data or errors on and off by pressing the “CRC On/Off” key. The CRC status will be reported on the second line of the display, alternating with the ID status.

Inserting ID Messages

- Toggle the ID message or cycle on and off with the “ID On/Off” key.

Editing ID Messages

Please read “ID Messages” on page 19 before you first attempt to edit a TSG 601 ID.

1. Enter the ID menu (press **Shift**, then **ID On/Off**).
2. Press the ▼ key once to reach the “Edit ID #X” menu item. Note that the ID# first shown on the display always indicates the *current* (most recently recalled) ID.
3. Use the horizontal arrow keys to display the number of the ID you want to edit, then press **ENTER**.
4. Use the arrow keys to move the character cursor. Specify the character with the letter keys; press **Shift** to select symbols and numbers. The “Sp” key will enter a space, blacking out the underlying test pattern. The test pattern will show through a “Blank” (Shift-SP).
5. When you have made all the desired changes, press **ENTER** to save them. *(Note: pressing any* rectangular *key will abort the edit and exit the ID menu.)* If the ID message you started with in step 3 was “on-screen” when you began the edit, the new message will take its place. If not, and you wish to insert the new message, press the ▲ key to reach the “Recall ID #X” menu item, select the ID number with the horizontal arrow keys, and press **ENTER**.
6. As usual, press any rectangular key to exit the ID menu.

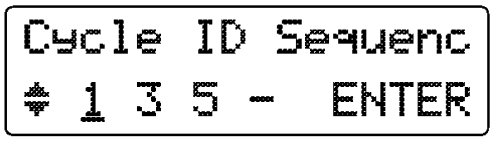
Positioning ID Messages

NOTE*. Only the position of the* currently displayed *ID may be changed. If you wish to change the picture location of a message that is not displayed, you must first recall it through the ID menu or the Recall menu.*

1. Enter the ID menu (press **Shift**, then **ID On/Off**), if necessary.
2. With the ▲ and ▼ keys, scroll to the "Position ID" menu item.
3. Press **ENTER**.
4. Use the arrow keys to move the message horizontally (H) and vertically (V) in the picture.
5. When the ID occupies the desired position, press **ENTER** to save the new location in memory and return to the ID menu. If you press any rectangular key *instead* of **ENTER**, the ID will remain in its new position—but will revert to the original location the next time it is recalled from memory.
6. As usual, press any rectangular key to exit the ID menu.

Setting up an ID Cycle

1. Edit and save the ID messages that you want to cycle (see "Editing ID messages," page 10). Note the numbers of the IDs, and the order in which they should appear.
2. Scroll through the ID menu to reach the "ID Cycle Setup" item, then press **ENTER**. The display will resemble the following illustration.



3. Use the ◀ / ▶ keys to move the underline cursor to one of the four sequence "time intervals." The IDs will appear in the order that their numbers appear (from left to right) on the display.

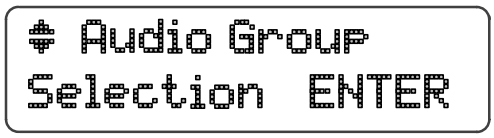
4. Use the ▲ / ▼ keys to select the number of the ID to appear during each interval. Choose the hyphen (it's below #1) to eliminate the interval. If you want a blank interval (that is, a time gap between ID messages), you must create an all-blank ID to put in that interval.
5. When the correct information is in all four time interval positions, press **ENTER** to confirm the cycle setup. (Press any rectangular key to abort the cycle edit.)
6. To set the duration of each cycle time interval, press the ▲ key to reach the "ID Cycle time" menu item. Use the horizontal arrow keys to select the duration between one and nine seconds. Press **ENTER** to confirm.
7. To replace the current ID with the ID cycle, scroll through the ID menu to the "ID Cycle OFF" selection. Press a horizontal arrow key to change the selection to "ID Cycle ON," then press **ENTER**. The cycle will appear in the picture if toggled on with the "ID On/Off" key.

Inserting Embedded Audio

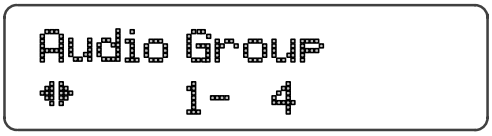
- Press the "Audio On/Off" key to alternately enable and disable embedded audio in the serial data stream.

Though the TSG601 will provide 16 channels of audio, it can only output a maximum of 4 channels at a time. Therefore the 16 channels have been broken up into 4 Groups of 4 channels each. Please read "Embedded Audio" on page 19.

1. Enter the Audio menu (press **Shift,** then **Audio On/Off**). The display will look something like this:



2. Go into the Audio Group Selection menu by pressing the ENTER key. The display will change to:



3. Use the ◀ and ▶ keys to select the desired group of audio channels (1–4, 5–8, 9–12, or 13–16). Press **ENTER** to confirm the selection.
4. Press any rectangular key to exit the Audio menu, or use the ▲ / ▼ keys to go to the next selection within the Audio menu.

Specifying Inserted Audio Channels in the Group

When embedded audio is enabled, there must be at least two channels selected. This menu item allows you to select channels 1 and 2, channels 3 and 4, or channels 1, 2, 3, and 4.

1. If necessary, enter the Audio menu (press **Shift**, then **Audio On/Off**).
2. Use the down key to scroll to the "Audio Channel Selection" item, and press the **ENTER** key. The display will look something like this:

3. Use the ◀ and ▶ keys to select the audio channel set. Press the **ENTER** key to confirm the selection.
4. Press any rectangular key to exit the Audio menu, or use the ▲ / ▼ keys to go to the next selection within the Audio menu.

Specifying Audio Channel Frequencies

The TSG601 allows the selection of one of 26 different frequencies plus mute for each individual channel within the group. The frequency of each channel within the group will be the same in all the groups. To change the frequency assignments, do the following:

1. If necessary, enter the Audio menu (press **Shift**, then **Audio On/Off**).

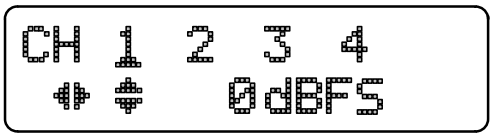
2. Scroll down to the “Audio Frequency Selection” item and press the **ENTER** key. The display will resemble this:

3. Use the ◀ and ▶ keys to select the desired audio channel, and use the ▲ and ▼ keys to select the frequency for that channel. Press the **ENTER** key to confirm these choices. If a change was made, the display will momentarily show the channel numbers that have new frequency assignments.
4. Press any rectangular key to exit the Audio menu, or use the ▲ / ▼ keys to go to the next selection within the Audio menu.

Changing Audio Channel Amplitudes

Each audio channels output amplitude may be set from 0 dBFS to –20 dBFS, in 1.0 dB increments. The following steps show how to do this.

1. If necessary, enter the Audio menu (press **Shift**, then **Audio On/Off**).
2. Scroll down to the “Audio Amplitude Selection” item and press the **ENTER** key. The display will look something like this:

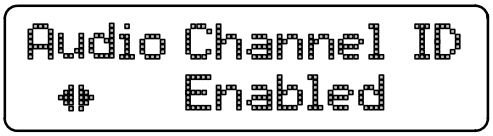


3. Use the ◀ and ▶ keys to select the desired audio channel, and use the ▲ and ▼ keys to select the amplitude for that channel. Press the **ENTER** key to confirm these choices.
4. Press any rectangular key to exit the Audio menu, or use the ▲ / ▼ keys to go to the next selection within the Audio menu.

Audio Channel ID

Source ID in the audio channel status bits may be enabled or disabled through this menu item. Channel ID's are preset to ch1 (channel 1), ch2 (channel 2), ch3 (channel 3), and ch4 (channel 4).

1. If necessary, enter the Audio menu (press **Shift**, then **Audio On/Off**).
2. Scroll down to the "Audio Amplitude Selection" item and press the **ENTER** key. The display will be similar to:



3. Use the ◀ and ▶ keys to toggle the ID between the enabled and disabled states. Press the **ENTER** key to select the displayed state. If the state was changed, the display will show each of the four channels momentarily, while the SRAM is updated.
4. Press any rectangular key to exit the Audio menu, or use the ▲ / ▼ keys to go to the next selection within the Audio menu.

Cable Simulation

- To simulate the addition of 50 meters of 75 Ω coaxial cable anywhere in your system, connect the TSG 601 into the signal path with the two BNCs marked "APPROX 50M CABLE." The connectors are interchangeable, and the circuit will accurately simulate 50 m of Belden 8281 cable—which attenuates the signal by approximately 5.4 dB at 135 MHz—whether the TSG 601 is switched on or off.

Detecting Incorrect Termination

- A special T symbol will "flash" in the upper right corner of the TSG 601 display to indicate improper termination of the serial video signal path. The symbol is displayed whenever the instrument detects return loss below approximately 10 dB, which approximates termination impedance of less than 37.5 Ω or greater than 150 Ω.

Saving (Storing) Presets and IDs

1. Press **Shift** and then **Recall**. Note that the ID# first shown on the display always indicates the *current* (most recently recalled) ID.
2. Scroll through the "STORE ID" (#1 through #8) and "STO PRESET" (#1 through #4) locations with the left/right arrow keys. The first line of any ID message already stored in the # location will be shown in the bottom line of the display; use the ▼ key to see the second message line. Remember that storing the current settings or ID will overwrite the contents of the Preset or ID # location.
3. When the desired storage number is displayed, press **ENTER** to save the current ID or Instrument settings. If you have stored an ID, it will replace the old # contents on the bottom display line.
4. Press any rectangular key to exit the Store function.

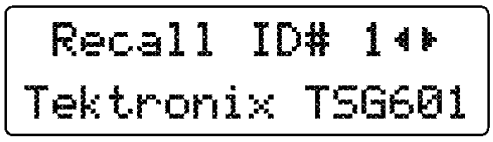
Note that IDs are normally saved—when they are edited—through the ID menu (see "Editing ID messages," page 10). You may use the Recall/Store button, however, if you wish to copy the current ID to another memory location. Remember that the "current" ID is the last message recalled through the ID menu or **Recall**; the ID will be copied (and the previous contents of the ID# location overwritten) even when no message appears in the TSG 601 output (ID=Off).

A preset includes all of the instrument settings in effect when the preset is saved, including the current output format, test signal, ID#, and cycle setup. Note that ID messages themselves are not stored. Thus, if a Preset "remembers" to display ID#4 (for example), the *latest* message in ID#4 will appear whenever that Preset is recalled. Remember, editing an ID message *can* have an affect on what you get when you recall a preset.

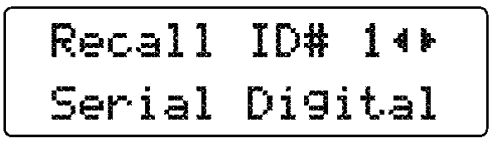
Recalling Presets and IDs

1. Press the Recall key. Note that the ID# first shown on the display always indicates the *current* (most recently recalled) ID.
2. Scroll through the "RECALL ID" (#1 through #8) and "RCL PRESET" (#1 through #4) locations with the ◀ / ▶ keys. The first line of an ID message will occupy the bottom line of the display; use the ▼ key to see the second line. For example, the

"factory" ID#1 is "Tektronix TSG601 Serial Digital." The display will first look like this:



Pressing the ▼ key will change it to this:



You may find this feature useful if you save two or more IDs with the same first line of text.

3. When the desired storage number is displayed, press **ENTER** to recall the ID or Preset.
4. Press any rectangular key to exit the Recall menu.

Details

CRCs

CRCs (Cyclic Redundancy Codes) are used in serial digital video systems as a means of error detection and handling (EDH). This section attempts to explain CRCs and their use, and freely paraphrases the proposed SMPTE recommended practice on the topic, RP 165. Those familiar with the concepts should skip down to "TSG 601 CRC Options," below, for a discussion of the available CRCs.

Checkwords. CRCs are binary numbers that are computed from the digital samples in the serial digital video frame. The CRCs serve a similar function as the Parity Bit in the familiar RS-232 serial interface, but with much more sophistication. The transmitting device calculates the CRC from the information it is sending, encodes it into a *checkword*, and inserts the value into the transmitted data stream. The receiving device calculates the CRC from the received information, decodes the received checkword, and compares the two num-

bers. If they are the same, we can be very confident that the picture data has been transmitted correctly. Unequal numbers mean that something has gone wrong in the process, and that the received data is not identical to the data that was sent. Many receiving devices will report the discrepancy as an error.

The TSG 601 is a transmitting device, and the companion SDA 601 is a receiving device. A digital VTR, of course, can be both.

Types of CRC. Two CRC checkwords are defined in SMPTE RP 165: one derived from a full field of samples, and another based on samples from the active picture area only. The first is known as the Full Field CRC (FFCRC) while the other is called the Active Picture CRC (APCRC). The checkwords are transmitted in the "ancillary data" area of the vertical interval portion of the digital video data stream.

Because some digital video equipment strips or ignores the vertical interval, Tektronix engineers have devised another way of using the Active Picture CRC that does not depend on a checkword embedded in the serial data stream. It is called the Zero Active Picture CRC (∅APCRC). For the ∅APCRC, the transmitting device computes the APCRC as usual until the last five samples of the picture; then, the transmitter produces five samples that will force the APCRC to equal zero. If the receiving equipment also computes an APCRC of zero from the received digital video, we can be as confident of error-free transmission as with the standard APCRC—even when the vertical interval portion is missing from the serial video data.

TSG 601 CRC options. The TSG 601 can generate:

Normal FFCRC	Normal APCRC
Erroneous FFCRC	Erroneous APCRC
	∅APCRC

The Normal CRCs are calculated and encoded in accordance with the (proposed) SMPTE recommended practice RP 165. The erroneous (or "forced error") CRCs are created by beginning and ending the computation one sample later than specified in RP 165. The erroneous CRCs, therefore, will *always* differ from the correct value.

ID Messages

The TSG 601 lets the user edit ID messages "off line." This means that you can edit a message without affecting the instrument's output—or the ID currently inserted in the picture. To help prevent inadvertent changes to the current ID, the instrument will only insert ID messages that have been saved through the ID menu or the Store key.

In the TSG 601, there are eight numbered storage locations for ID messages, ID#1 through ID#8. Each location contains a simple "factory" message when the instrument is new (or immediately after a "FACTORY RESET"—see page 57).

The procedure for creating and displaying a new message is:

1. Select an existing ID# for editing;
2. Change the message as desired (see page 10);
3. Save the changes (by pressing **ENTER**); and
4. Later recall that ID# through the ID menu or the Recall key.

If you edit the *current* ID# (that is, the one in the TSG output when you begin the edit), the on-screen message will change in step 3. If you edit a different ID#, the message will not change in step 3; rather, you'll have to perform step 4 to insert the new message. If you edit an ID# that is part of a currently active ID cycle, the new message will take the place of the old one the first time the ID# appears *after* step 3.

To minimize the chance of outputting a test signal with an incorrect ID message, please familiarize yourself with ID selection and editing *before* you use the TSG 601 in a critical application.

Embedded Audio

The TSG 601 embedded audio function provides 16 channels of audio. The maximum output, however, is four channels at a time, so the channels are divided into four groups of four channels:

Group 1	Channels 1 – 4
Group 2	Channels 5 – 8
Group 3	Channels 9 – 12
Group 4	Channels 13 – 16

Within the audio menus, the channels are called channels 1, 2, 3, and 4 of the group that you are working in. As there must be at least two channels (AES/EBU pairs) selected when embedded audio is enabled, you may select channels 1 and 2, channels 3 and 4 or channels 1, 2, 3, and 4.

Separate frequencies and amplitudes may be assigned to each of the four channels. The frequency and amplitude assigned to a channel will be the same for that channel in all four groups. The frequency may be set to any of 26 provided frequencies, or mute. The amplitude for each channel may be set in 1 dB increments from 0 dBFS to –20 dBFS.

The embedded audio function also provides a source ID for each channel. This ID is enabled or disabled for the whole group of four channels at a time. When enabled, the source ID applies ch1, ch2, ch3, and ch4 to the appropriate channels Status Bits, as shown in Table 7. Audio sample distributions are shown in Tables 8 and 9.

The SDI Checkfield Signals

SDI (serial digital interface) Checkfield signals—also known as Pathological signals—are designed to test the low frequency response of serial digital video equipment. The three SDI Checkfield signals in the TSG 601 are defined in the (proposed) SMPTE Recommended Practice RP 178; they are the Cable Equalization (Equalizer), Phase Locked Loop (PLL), and Matrix Checkfields.

The Equalizer SDI Checkfield signal tests the automatic equalizer circuits of receiving equipment. It has been arranged to create a serial data stream with the maximum possible dc content. In practice, the digital data contains a repeating pattern of 19 high or low states followed by one opposite state; thus, for the longest possible period (several times each field), the signal will be essentially “dc,” with opposite polarity states occurring only once in every twenty clock intervals.

The PLL Checkfield Signal tests the equipment’s ability to lock to the serial data stream. It has been configured to give the serial data the maximum possible low frequency content and the fewest possible zero crossings; that is, the longest possible time between high–low or low–high transitions in the signal. In practice, the data contains—several times each field—a repeating pattern of 20 high states fol-

lowed by 20 low states. This is the lowest frequency possible, given the data encoding schemes that are specified in the serial digital video standards.

The third TSG 601 SDI Checkfield signal is a matrix of the other two. For a much more complete discussion of SDI Check Fields and their use, please see SMPTE RP 178 and Tektronix publication 25W-7203-1, “A Guide to Digital Television Systems and Measurements.”

Appendices

Appendix A: Characteristics

The information in this section is included for the convenience of the TSG 601 operator. It is not intended as a complete list of guaranteed specifications. The waveform illustrations represent properly decoded output. For a full list of instrument specifications, as well as performance verification and adjustment procedures, please see the TSG 601 Service Manual (Tektronix p/n 070-8911-XX).

***NOTE**. Shielded cables were used in the EMI certification of this instrument; therefore, it is recommended that shielded cables be used when operating. (EC 92)*

Safety Standard Compliance

The following safety standards apply to the TSG 601:

- ANSI S82 — Safety Standard for Electrical and Electronic Test, Measuring, Controlling, and Related Equipment, 1988.
- CAN/CSA C22.2 No. 231 M89 — CSA Safety Requirements for Electrical and Electronic Measuring and Test Equipment.
- IEC1010-1 — Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use (1990).
- UL1244 — Standard for Electrical and Electronic Measuring and Testing Equipment, Second Edition (1980).

Specification Tables

Table 1: Test Signal Characteristics

Characteristic	Information
75% Color Bars	See Figures 1, 2, and 3, and Table 12
100% Color Bars	See Figures 4, 5, and 6, and Table 12
Pluge (BBC 1)	See Figure 7 and Table 13
Field Timing, 625/50	
700 mV	Lines 83–166
105 mV	Lines 167–250
Field Timing, 525/60	
700 mV	Lines 72–142
105 mV	Lines 143–212
Pluge (BBC 2)	See Figures 8 and 9, and Table 13
Field Timing, 625/50	
700 mV	Lines 63–114
450 mV	Lines 115–166
200 mV	Lines 167–218
110 mV	Lines 219–270
Field Timing, 525/60	
700 mV	Lines 55–98
450 mV	Lines 99–142
200 mV	Lines 143–185
110 mV	Lines 186–229
5-Step Staircase	See Figures 10 and 11, and Table 14
Amplitude	
Y channel	0 to 702.4 mV in 176-word steps
B–Y, R–Y	–351.6 to +351.6 mV in 180-word steps
Mod 5-Step	See Figures 10, 12. and 13
Amplitude	
Y channel	0 to 702.4 mV in 176-word steps
525 B–Y, R–Y	–157.3 mV
625 B–Y	83.7 mV
625 R–Y	94.4 mV
Limit Ramp	See Figures 14 and 15 In 8-bit, extends from word 01 to 254 In 10-bit, extends from word 04 to 1016

Table 1: Test Signal Characteristics (Cont.)

Characteristic	Information
Shallow Ramp	See Figures 16 and 17
Amplitude	80 mV
Pedestal (variable)	
Y channel	0 to 700 mV
B–Y, R–Y	–350 to +350 mV
Risetimes	
Y channel	200 ns Nominal
B–Y, R–Y	280 ns Nominal
Mod Pulse and Bar (625 lines/50 Hz)	See Figures 18, 19, and 20
4T Pulse HAD	400 ns
10T Pulse HAD	1000 ns (1.0 μs)
Pulse Amplitude	
Y	350.0 mV
B–Y	196.3 mV
R–Y	248.1 mV
2T Pulse HAD	200 ns (Y channel only)
Mod Pulse and Bar (525 lines/60 Hz)	See Figures 21, 22, and 23
12.5T Pulse HAD	1562.5 ns (in NTSC, encodes to 12.5T modulated pulse, ∅ = 60.7°)
Pulse Amplitude	
Y	350.0 mV
B–Y	196.3 mV
R–Y	248.1 mV
2T Pulse HAD	200 ns (Y channel only)
60% Line Sweep W/Markers	See Figures 24 and 25
Amplitude	420 mV
Frequency Range	
Y channel	250 kHz–5.75 MHz
R–Y, B–Y	125 kHz–2.75 MHz
Marker Frequencies	
Y channel	0.5, 1, 2, 3, 4, and 5 MHz
R–Y, B–Y	0.25, 0.5, 1, 1.5, 2, and 2.5 MHz
500 kHz Bowtie	See Figures 26, 27, and 28
Y channel	500 kHz sine wave
R–Y, B–Y	502 kHz sine wave
Amplitude	350 mV

Table 1: Test Signal Characteristics (Cont.)

Characteristic	Information
Convergence	See Figures 29 and 30
Amplitude	525 mV (75%)
Pattern	Crosshatch: 14 horiz./15 vert. lines
Pulse HAD	225 ± 25 ns
Equalizer SDI Checkfield	Per SMPTE RP 178
PLL SDI Checkfield	Per SMPTE RP 178
Matrix SDI Checkfield	Per SMPTE RP 178
Field Timing, 625/50	
Equalizer	Lines 24 through 166
PLL	Lines 167 through 310
Field Timing, 525/60	
Equalizer	Lines 21 through 141
PLL	Lines 142 through 262
Active Picture Markers	See Figures 31, 32, and 33, and Table 15
Field Timing, 625/50	
Vertical limits	Lines 24 and 310
Horizontal limits	Lines 25 through 309
Field Timing, 525/60	
Vertical limits	Lines 21 and 262
Horizontal limits	Lines 22 through 261

Table 2: Encoding Parameters

Characteristic	Information
Standards Conformance	CCIR rec 601
Coded Signals	Y, B–Y, and R–Y
Samples per complete line	525/60; 625/50
Luminance (Y)	858; 864
Color Difference (B–Y, R–Y)	429; 432
Sampling Structure	Orthogonal, line, field, and picture repetitive. R–Y and B–Y samples co-sited with odd (1st, 3rd, 5th, etc.) Y samples in each line.

Table 2: Encoding Parameters (Cont.)

Characteristic	Information
Sampling Frequency	
Luminance (Y)	13.5 MHz
B–Y and R–Y	6.75 MHz
Form of Coding	Uniformly quantized PCM, 10 bits per sample, for the luminance signal and each color difference signal.
Samples/Digital Active Line	
Luminance (Y)	720
B–Y and R–Y	360
Video Signal/Quantization Level Correspondence	(10 bit video; quantization levels 0 to 1023)
Luminance (Y)	Spans 877 quantization levels, with black (0 mV) corresponding to level 64 and peak white (700 mV) corresponding to level 940.
B–Y and R–Y	Spans 897 quantization levels in the center of the quantization scale. Level 512 corresponds to 0 mV, level 64 to –350 mV, and level 960 to +350 mV.

NOTE. *Performance Requirements in the following tables are valid only if the instrument has been adjusted at approximately 25° C, is being operated within environmental limits (see Table 11), and has had a minimum warm-up of 20 minutes.*

Table 3: Serial Digital Video Output

Characteristic	Performance Requirements	Supplemental Information
Connectors		3 BNCs, 75 Ω
Number of Outputs		1 component serial video.
Digital Format		CCIR 601 Component 525/625, 8 or 10 bits data, scrambled NRZI; complies with CCIR 656 and SMPTE 259M.
Bit Rate		270 Mb/s
Source Impedance		75 Ω

Table 3: Serial Digital Video Output (Cont.)

Characteristic	Performance Requirements	Supplemental Information
Return Loss	≥ 15 dB, 5 MHz–270 MHz	Instrument switched on
Termination Detector		Triggers display **T** symbol when return loss of the signal path is ≤10 dB (approximates termination impedance of ≤37.5 Ω and ≥150 Ω).
Signal Amplitude		Variable from 600 mV to 1000 mV in the following steps: Coarse — 100 mV increments on even 100 mV levels Fine — 20 mV increments
Absolute accuracy		
at 800 mV setting	800 ± 20 mV	
Relative accuracy		
Coarse increments	100 ± 8 mV	From last 100 mV setting
Fine increments	20 ± 8 mV	
DC Offset	0 ± 0.5 Volts	
Rise and Fall Times	400–1000 ps	20% to 80% amplitude points
Jitter	less than ± 360 ps	over one line
Error Detection Ancillary Data		Active picture CRC (0-AP-CRC, Tek proprietary) on lines 9 & 272 (525) or 5 & 318 (625). EDH (SMPTE RP-165)

Table 4: Cable Simulator

Characteristic	Performance Requirements	Supplemental Information
Length		–5.4 dB ± 0.5 dB at 135 MHz (Approximates a 50 meter length of Belden 8281 coax cable)
Return Loss	≥ 20 dB from 5 MHz to 270 MHz	

Table 5: Character Identification

Characteristic	Information
Characters Displayed	Two lines of up to 16 Characters per line
Display Position	Moveable over the Safe Action area of the field.
Character Amplitude	Black, 70 mV equivalent White, 630 mV equivalent

Table 6: Signal Characteristics for Embedded Serial Audio

Characteristic	Performance Requirements	Supplemental Information
Standards Conformance		SMPTE 259M, SMPTE 272M, and SMPTE 125M
Encoding Format		Linear PCM, two's complement binary representation
Audio Sampling Frequency		48.00 kHz, locked to video
Audio Channels	Four channels at a time (max). (Two AES/EBU pairs; one pair may be disabled at a time.)	Four groups with four channels per group. Only one group may be selected at a time.
Quantized Resolution		20 bits
Audio Tone Frequency		User selectable for each channel: 50 Hz, 100 Hz, 150 Hz, 200 Hz, 250 Hz, 300 Hz, 400 Hz, 500 Hz, 600 Hz, 750 Hz, 800 Hz, 1 kHz, 1.2 kHz, 1.5 kHz, 1.6 kHz, 2 kHz, 2.4 kHz, 3 kHz, 3.2 kHz, 4 kHz, 4.8 kHz, 6 kHz, 8 kHz, 9.6 kHz, 12 kHz, 16 kHz, and mute.
Audio Tone Amplitude		User selectable for each channel, from 0dB FS to –20 dB FS, in 1.0 dB increments.
Pre–emphasis		None implemented in data.
Channel Status Bits		Uses default settings except that Source ID bits may be set to identify each channel with a fixed code. See Table 7
Audio Sample Distribution		525 – See Table 8 625 – See Table 9

Table 7: Audio Channel Status Bits

Byte	Bit	Value	Function
0	0 1 2–4 5 6–7	1 0 100 0 01	Professional use of channel status Normal Audio Mode No emphasis Source Sampling frequency locked 48 kHz sampling frequency
1	0–3 4–7	0001 0001	Two-channel mode 192-bit block structure, preamble indicates start of block
2	0–2 4–5 6–7	000 000 00	Maximum 20 bit audio sample data Word length specified in bits 0–2 Reserved
3	0–7	0000 0000	Reserved
4	0–7	0000 0000	Reserved
5	0–7	0000 0000	Reserved
6	0–7	0000 0000 0110 0111	Source ID Disabled Source ID Enabled (ASCII “c”)
7	0–7	0000 0000 0110 1000	Source ID Disabled Source ID Enabled (ASCII “h”)
8	0–7	0000 0000 0011 0001 0011 0010 0011 0011 0011 0100	Source ID Disabled Source ID Enabled (ASCII “1” for channel 1) (ASCII “2” for channel 2) (ASCII “3” for channel 3) (ASCII “4” for channel 4)
9	0–7	0000 0000	Source ID
10	0–7	0000 0000	Unused
11	0–7	0000 0000	Unused
12	0–7	0000 0000	Unused
13	0–7	0000 0000	Unused
14	0–7	0000 0000	Unused
15	0–7	0000 0000	Unused
16	0–7	0000 0000	Unused

Table 7: Audio Channel Status Bits (Cont.)

Byte	Bit	Value	Function
17	0–7	0000 0000	Unused
18	0–7	0000 0000	Unused
19	0–7	0000 0000	Unused
20	0–7	0000 0000	Unused
21	0–7	0000 0000	Unused
22	0–3 4–7	0000 0000	Reserved Bytes 0–21 are reliable
23	0–7	0101 0111	Channel status cyclic redundancy character

Table 8: 525/59.94 Embedded Serial Audio Sample Distribution

Analog Field 1		Analog Field 2	
Line Numbers	Transmitted Samples	Line Numbers	Transmitted Samples
5	4	268 (5)	4
10	0	273 (10)	0
11	0	274 (11)	0
12	0	275 (12)	0
13 [1]	3/4		
17	4	280 (17)	4
29	4	292 (29)	4
41	4	304 (41)	4
53	4	316 (53)	4
65	4	328 (65)	4
77	4	340 (77)	4
89	4	352 (89)	4
101	4	364 (101)	4
113	4	376 (113)	4
125	4	388 (125)	4

Table 8: 525/59.94 Embedded Serial Audio Sample Distribution (Cont.)

Line Numbers	Transmitted Samples	Line Numbers	Transmitted Samples
137	4	400 (137)	4
149	4	412 (149)	4
161	4	424 (161)	4
173	4	436 (173)	4
185	4	448 (185)	4
197	4	460 (197)	4
209	4	472 (209)	4
221	4	484 (221)	4
233	4	496 (233)	4
245	4	508 (245)	4
257	4	520 (257)	4
All Other Lines	3	All Other Lines	3

1 Line 13 has 4 samples in fields 1, 5, and 9.

Table 9: 625/50 Embedded Serial Audio Sample Distribution

Analog Field 1		Analog Field 2	
Line Numbers	Transmitted Samples	Line Numbers	Transmitted Samples
5	4	317 (4)	4
6	0	318 (5)	0
7	0	319 (6)	0
8	0	320 (7)	0
15	4	327 (14)	4
25	4	337 (24)	4
35	4	347 (34)	4
45	4	357 (44)	4
55	4	367 (54)	4

Table 9: 625/50 Embedded Serial Audio Sample Distribution (Cont.)

Line Numbers	Transmitted Samples	Line Numbers	Transmitted Samples
65	4	377 (64)	4
75	4	387 (74)	4
85	4	397 (84)	4
95	4	407 (94)	4
105	4	417 (104)	4
115	4	427 (114)	4
125	4	437 (124)	4
135	4	447 (134)	4
145	4	457 (144)	4
155	4	467 (154)	4
165	4	477 (164)	4
175	4	487 (174)	4
185	4	497 (184)	4
195	4	507 (194)	4
205	4	517 (204)	4
215	4	527 (214)	4
225	4	537 (224)	4
235	4	547 (234)	4
245	4	557 (244)	4
255	4	567 (254)_	4
265	4	577 (264)	4
275	4	587 (274)	4
285	4	597 (284)	4
295	4	607 (294)	4
305	4	617 (304)	4
313	4		
All Other Lines	3	All Other Lines	3

Table 10: Physical Characteristics

Characteristic	Information
Height	5.6 cm (2.2 in)
Width	9.1 cm (3.6 in)
Depth	19.1 cm (7.5 in)
Net Weight TSG 601 alone With battery pack	 0.48 kg (1.06 lb) 0.68 kg (1.5 lb)
Shipping Weight	1.50 kg (3.31 lb), includes AC adapter

Table 11: Environmental Characteristics

Characteristic	Information
Temperature Operating Storage	 0° C to +35° C (32 to +95° F) –30° C to +65° C (–22 to +149° F)
Altitude Operating Storage	 to 15,000 feet (4572 m); IEC 1010-1 compliance to 2000 m to 50,000 feet (15420 m)
Equipment Type	Test
Equipment Class	Class III (as defined in IEC 1010-1, Annex H)
Installation Category	Category II (as defined in IEC 1010-1, Annex J) Note: Rated for indoor use only.
Pollution Degree	Pollution Degree 2 (as defined in IEC 1010-1)
Transportation	Meets the requirements of NTSB Test Procedure 1A, category II (24 inch drop)

Waveform Diagrams

***NOTE**. The following diagrams represent the analog equivalents of the TSG 601 digital test signals. Horizontal axis units are microseconds (µs) after the start of Digital Active Video. Unless specified in the caption, each illustration represents both 525 line/60 Hz and 625/50 Hz signals.*

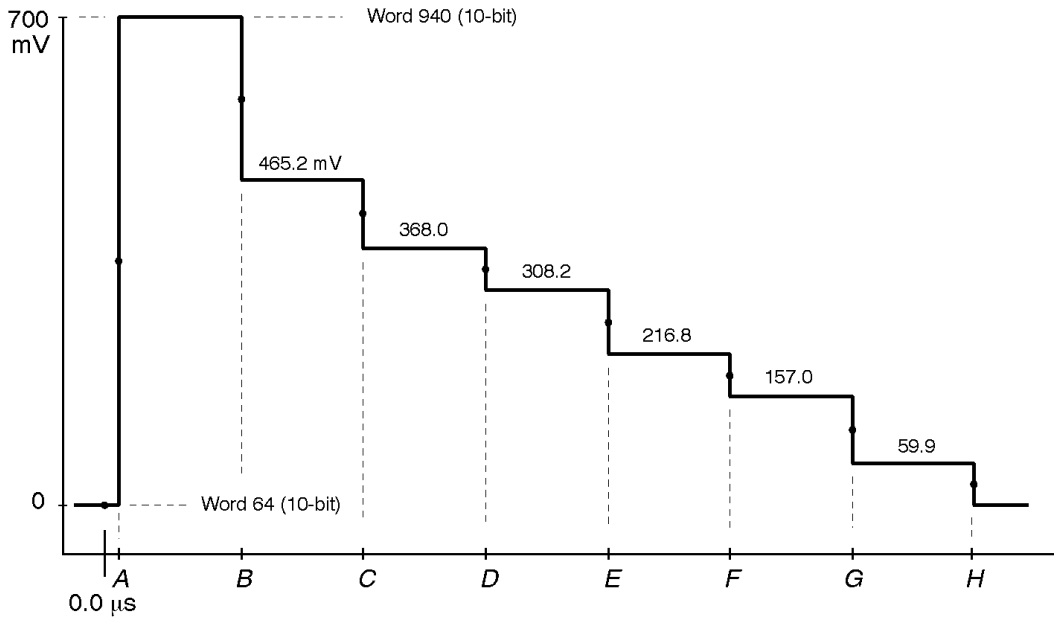


Figure 1: 75% Color Bars, Y

Table 12: 75% and 100% Color Bars Timing

	A	B	C	D	E	F	G	H
625/50	0.74 µs	7.26	13.70	20.22	26.74	33.18	39.70	46.15
525/60	0.37 µs	6.96	13.56	20.07	26.67	33.26	39.85	46.37

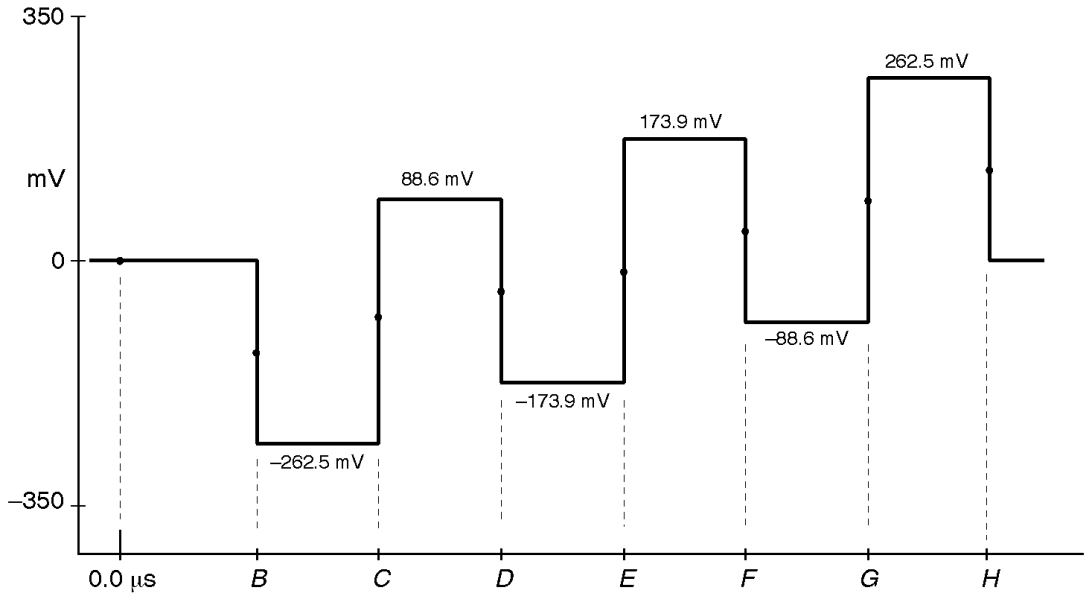


Figure 2: 75% Color Bars, B–Y

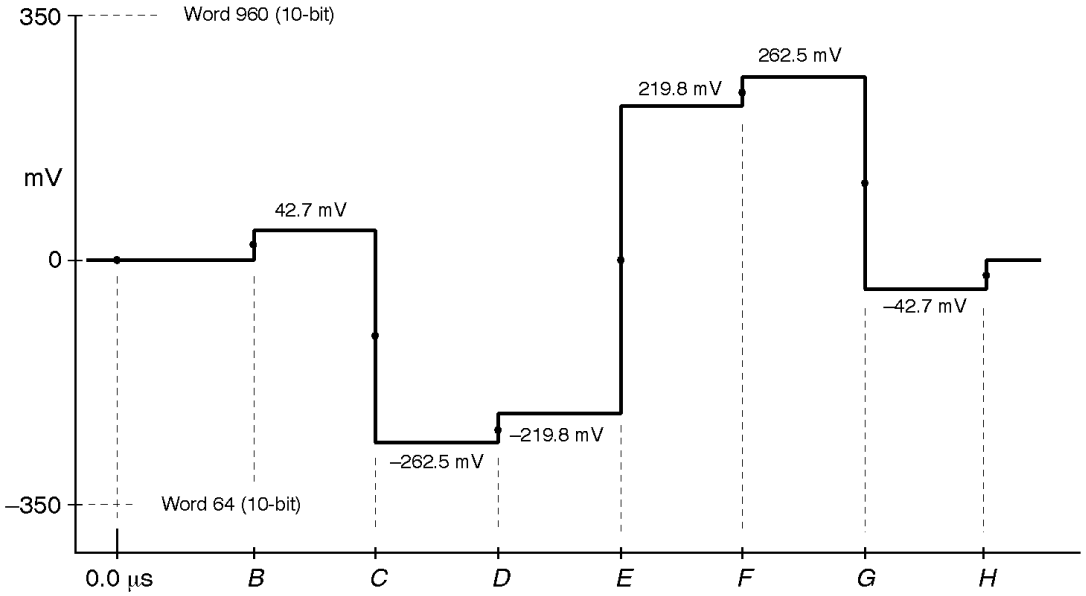


Figure 3: 75% Color Bars, R–Y

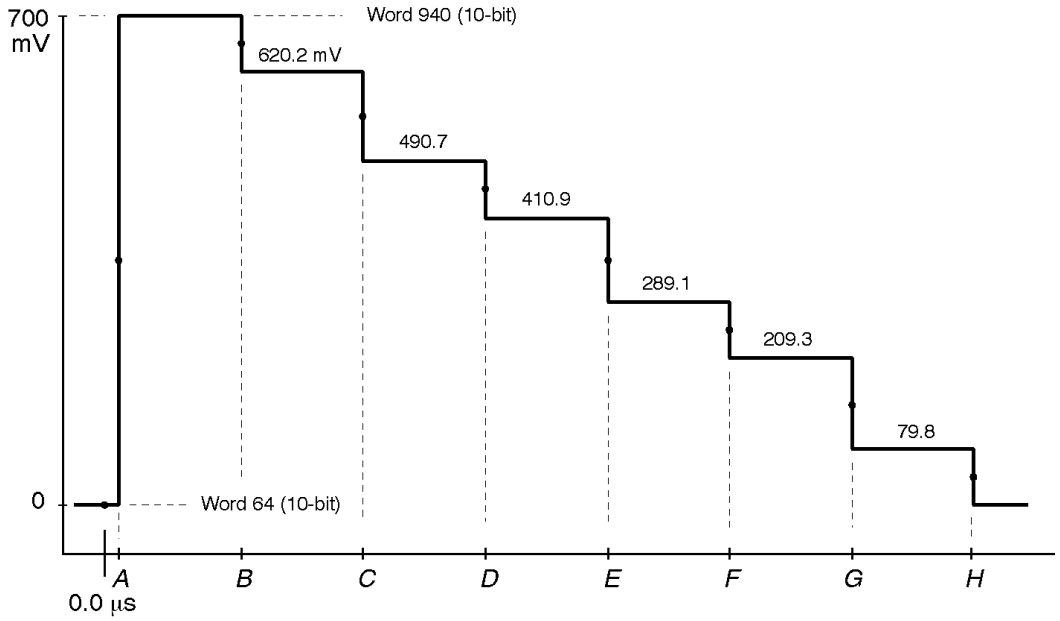


Figure 4: 100% Color Bars, Y

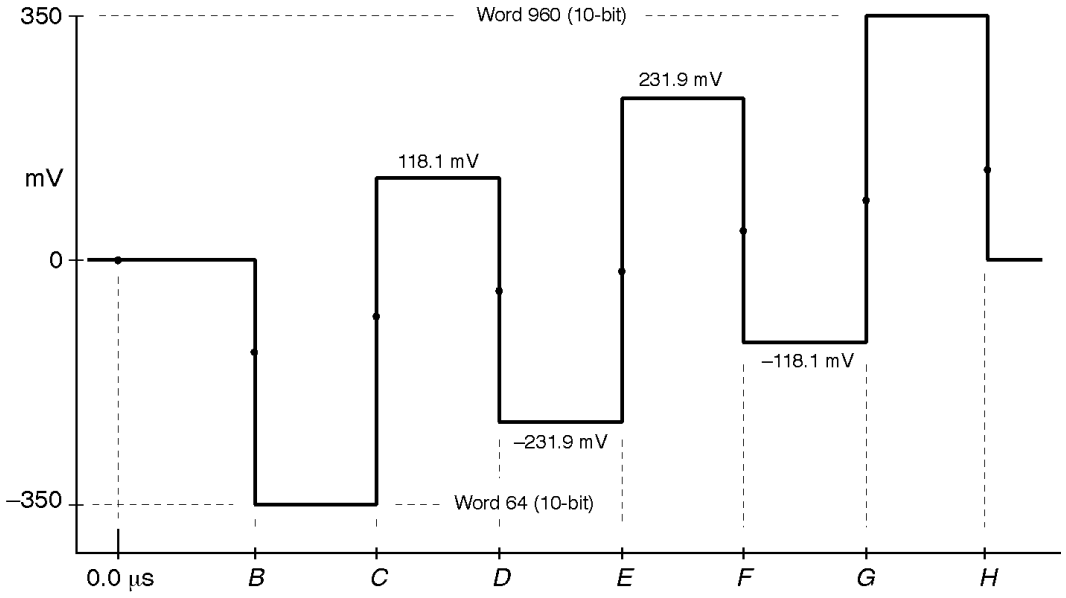


Figure 5: 100% Color Bars, B–Y

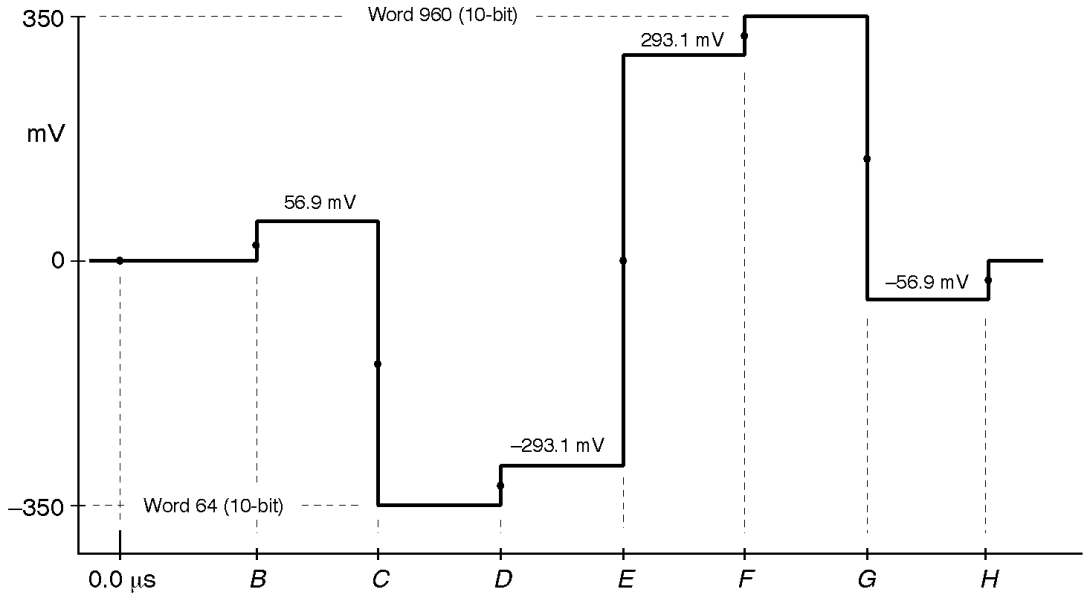


Figure 6: 100% Color Bars, R–Y

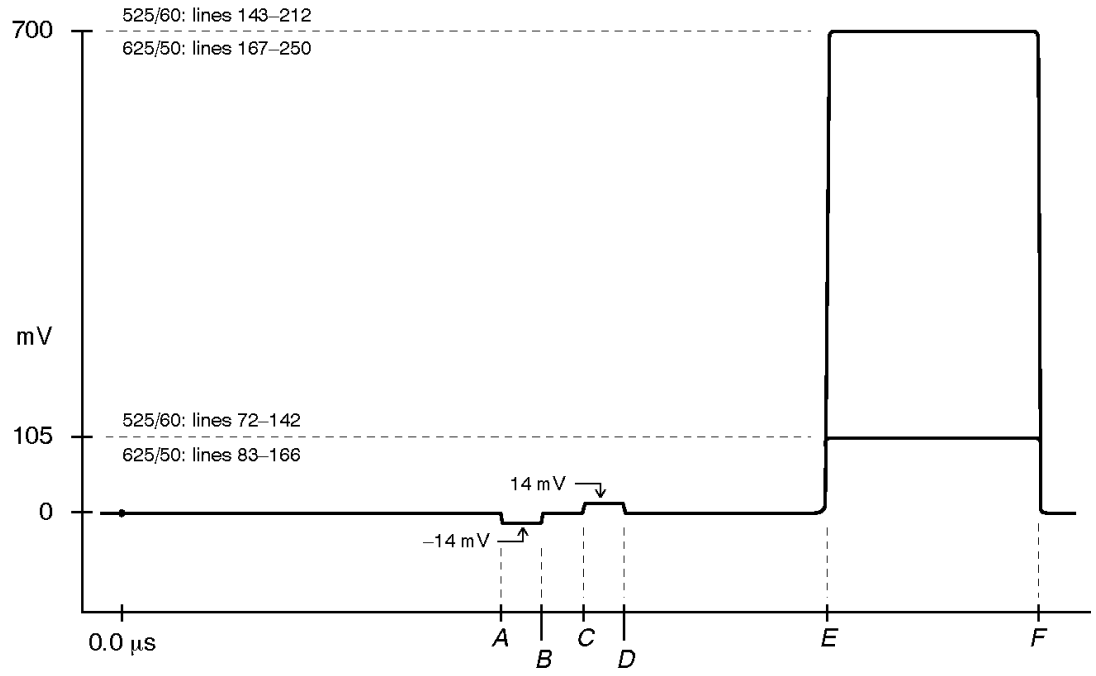


Figure 7: Pluge 1, Y only

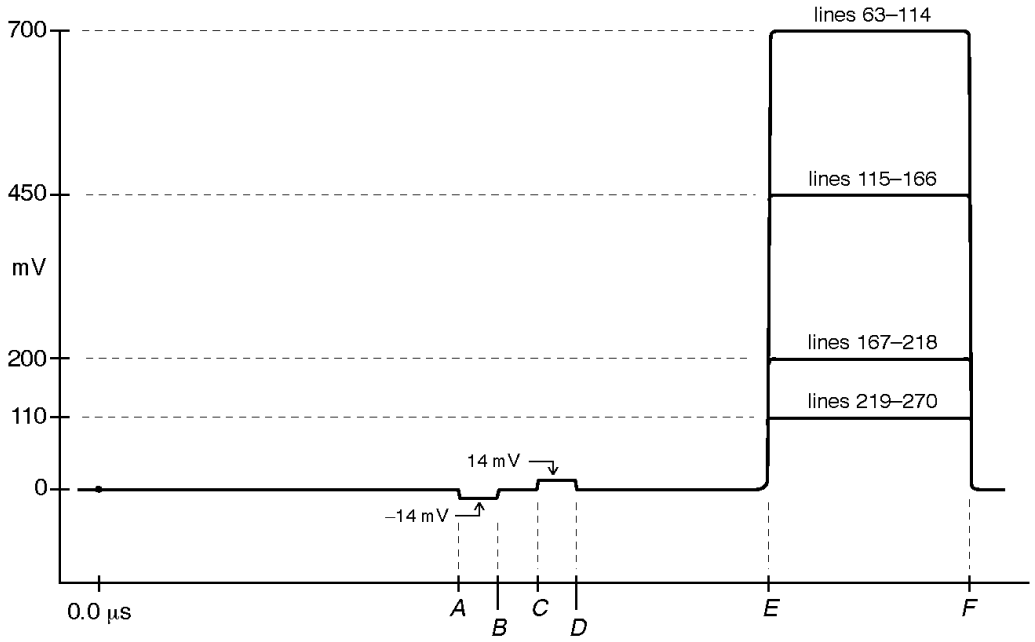


Figure 8: 625 Line Pluge 2, Y channel only

Table 13: Pluge Timing

	A	B	C	D	E	F
625 & 525	21.57 µs	23.87	26.17	28.47	40.07	52.07

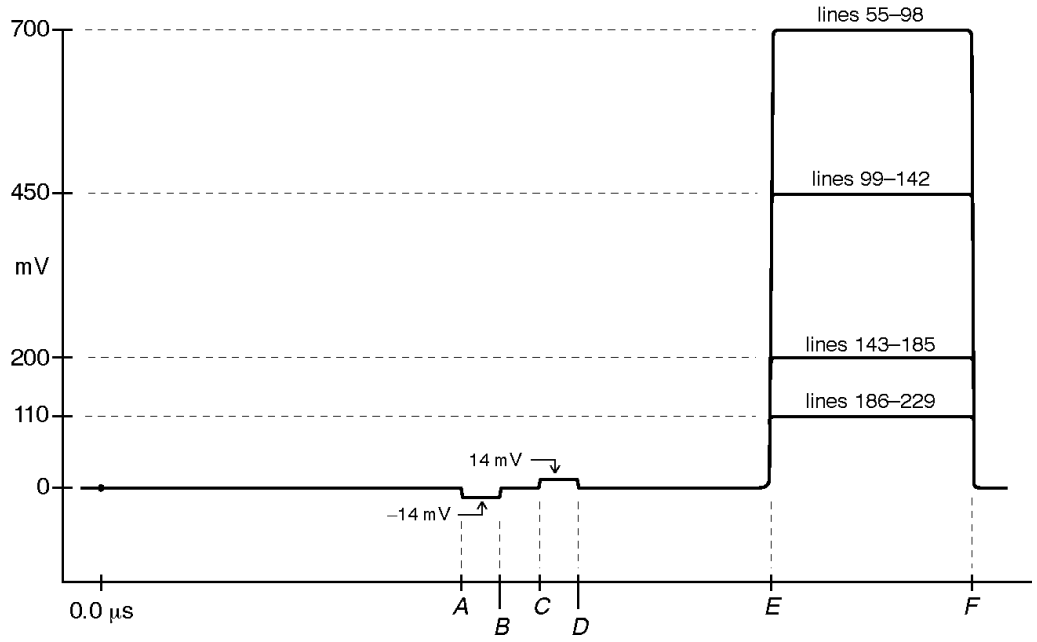


Figure 9: 525 Line Pluge 2, Y only

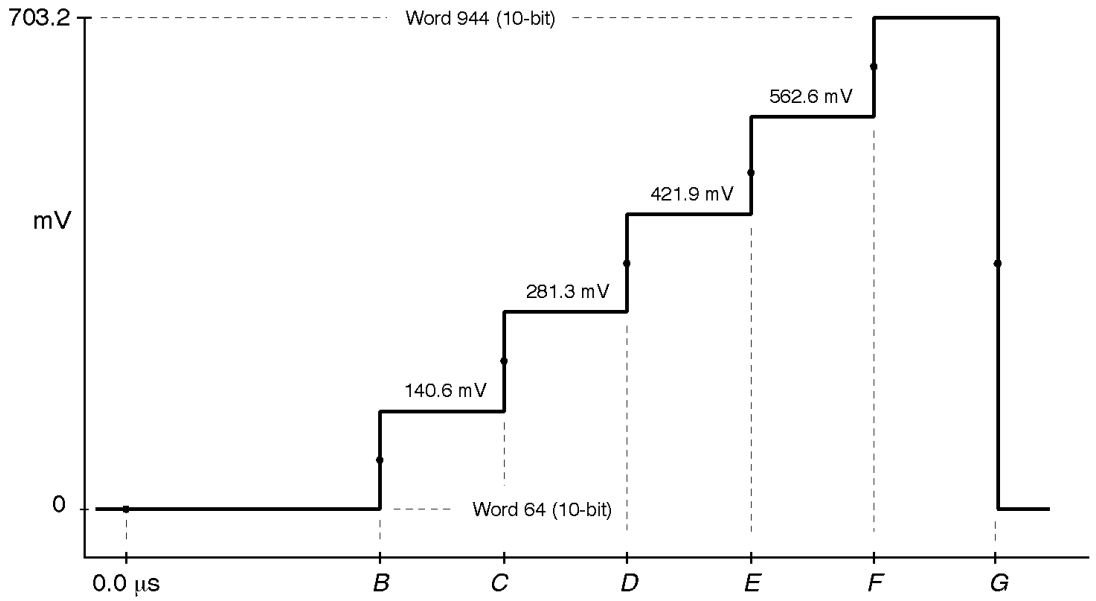


Figure 10: 5-Step Staircase and Modulated 5-Step, Y

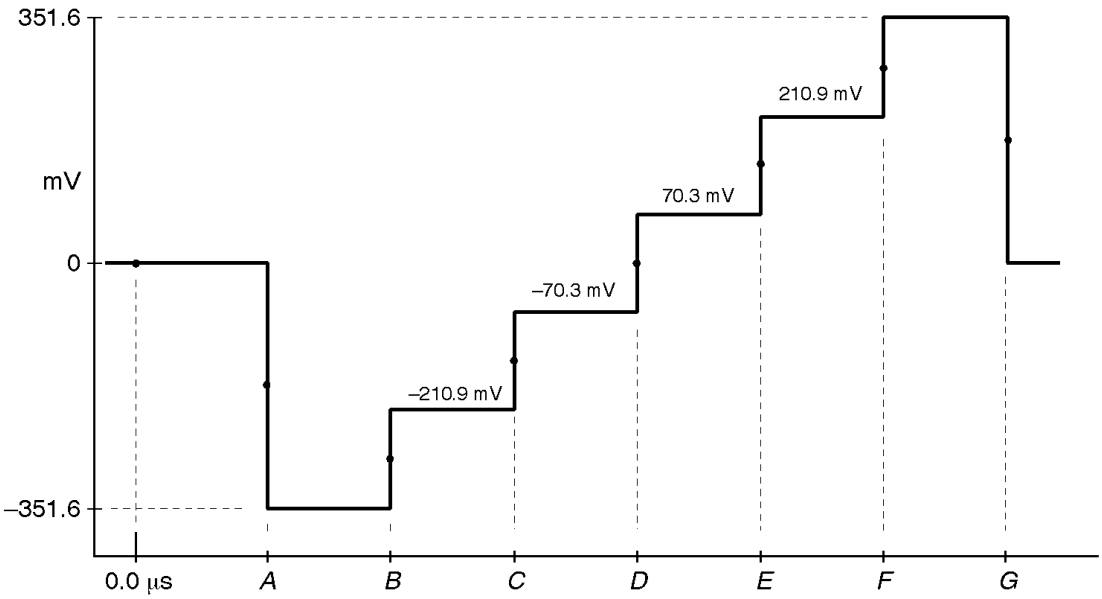


Figure 11: 5-Step Staircase, B–Y and R–Y

Table 14: 5-Step Staircase and Modulated 5-Step Timing

	A	B	C	D	E	F	G
625 & 525	6.96 µs	13.48	20.07	26.59	33.18	39.70	46.30

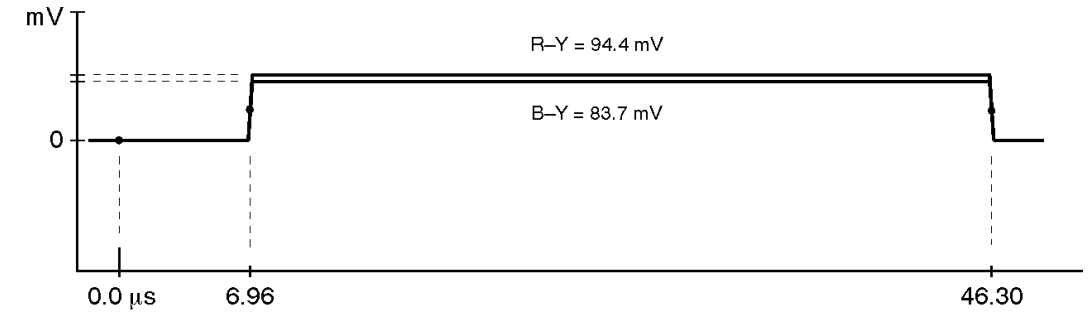


Figure 12: 625 Line Modulated 5-Step, B–Y and R–Y

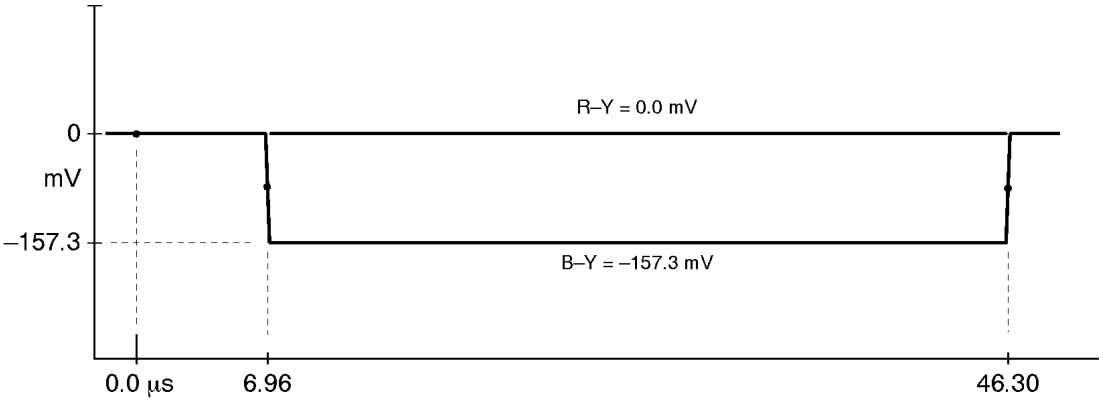


Figure 13: 525 Line Modulated 5-Step, B–Y and R–Y

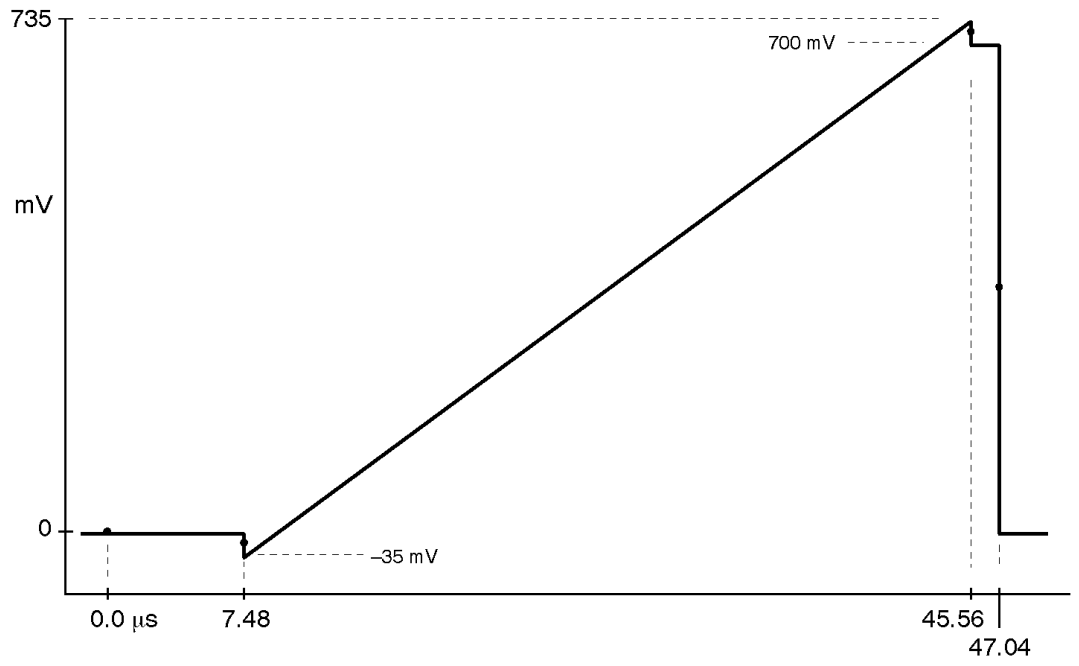


Figure 14: Limit Ramp, Y

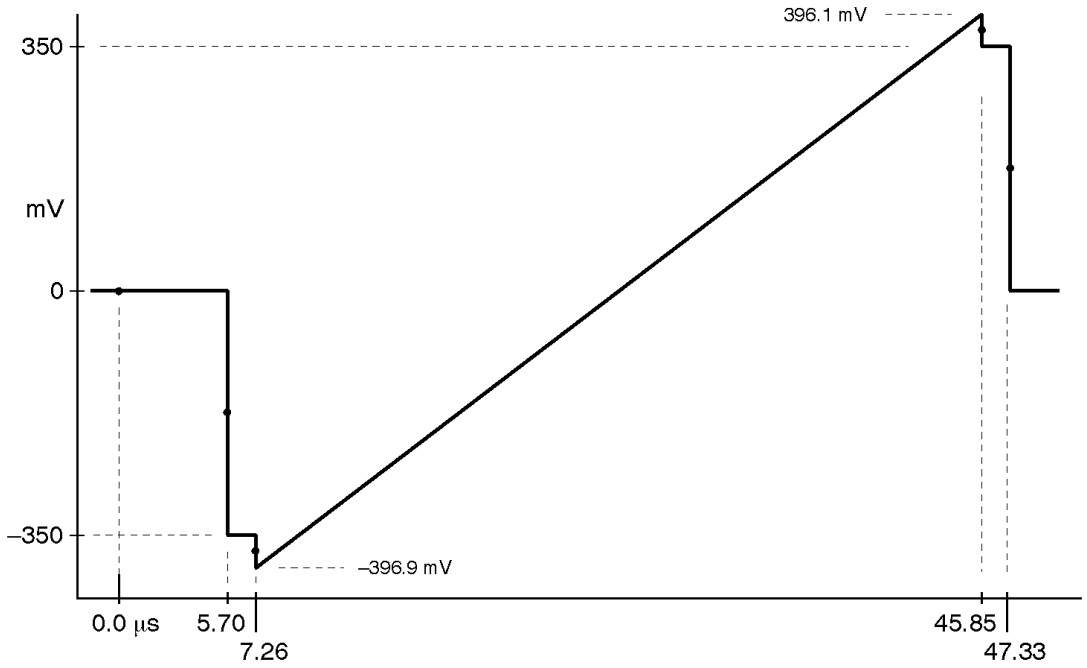


Figure 15: Limit Ramp, B–Y and R–Y

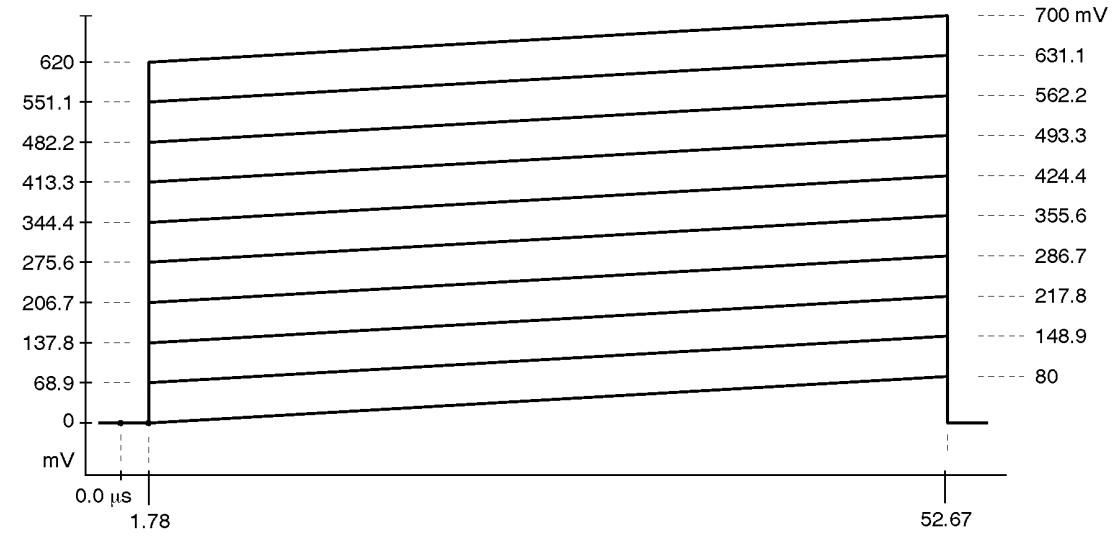


Figure 16: Shallow Ramp (10 possible amplitudes), Y

Figure 17: Shallow Ramp (10 possible amplitudes), B–Y and R–Y

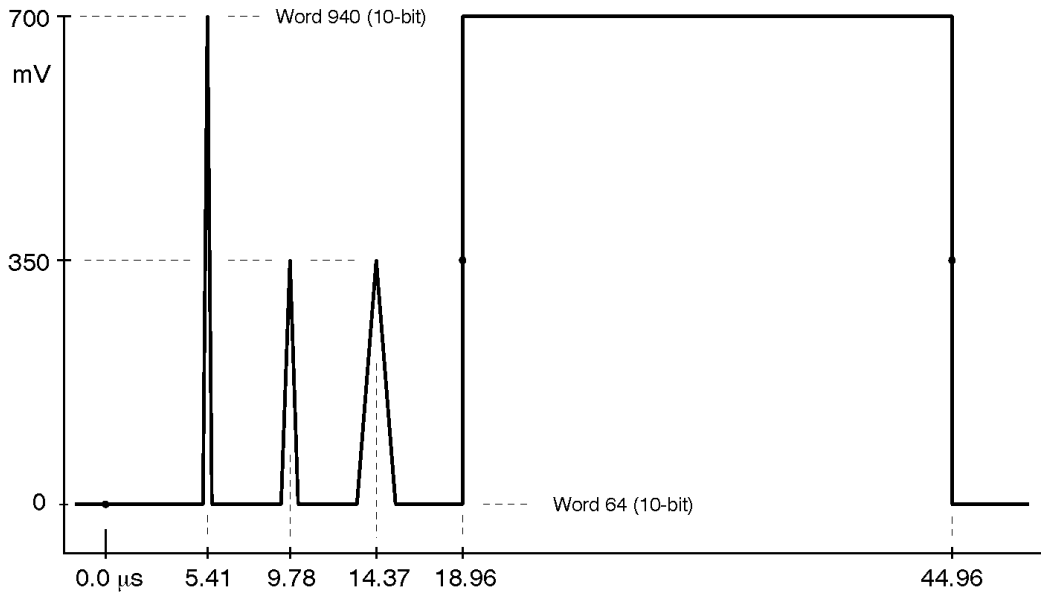


Figure 18: 625 Line Mod Pulse and Bar, Y

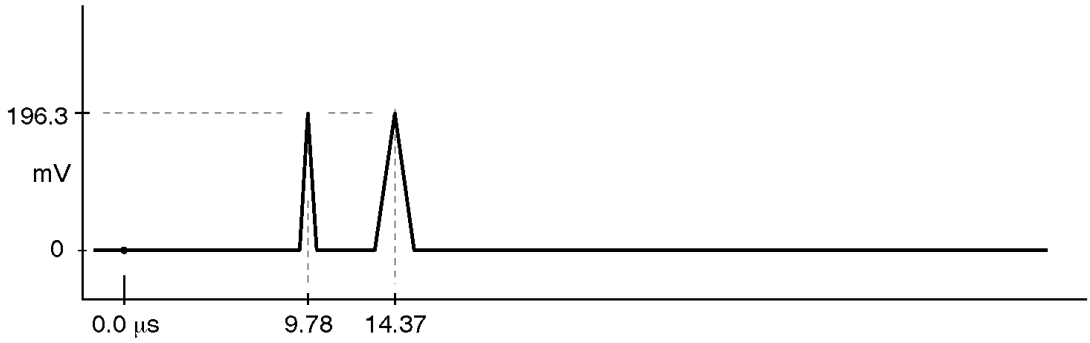


Figure 19: 625 Line Mod Pulse and Bar, B–Y

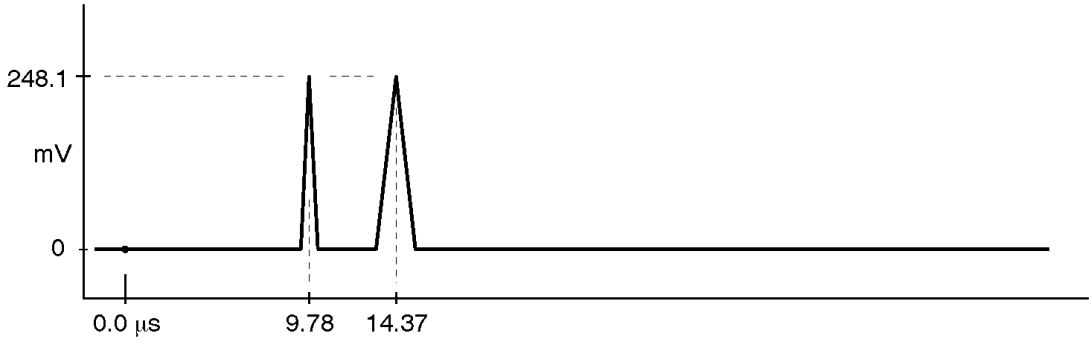


Figure 20: 625 Line Mod Pulse and Bar, R–Y

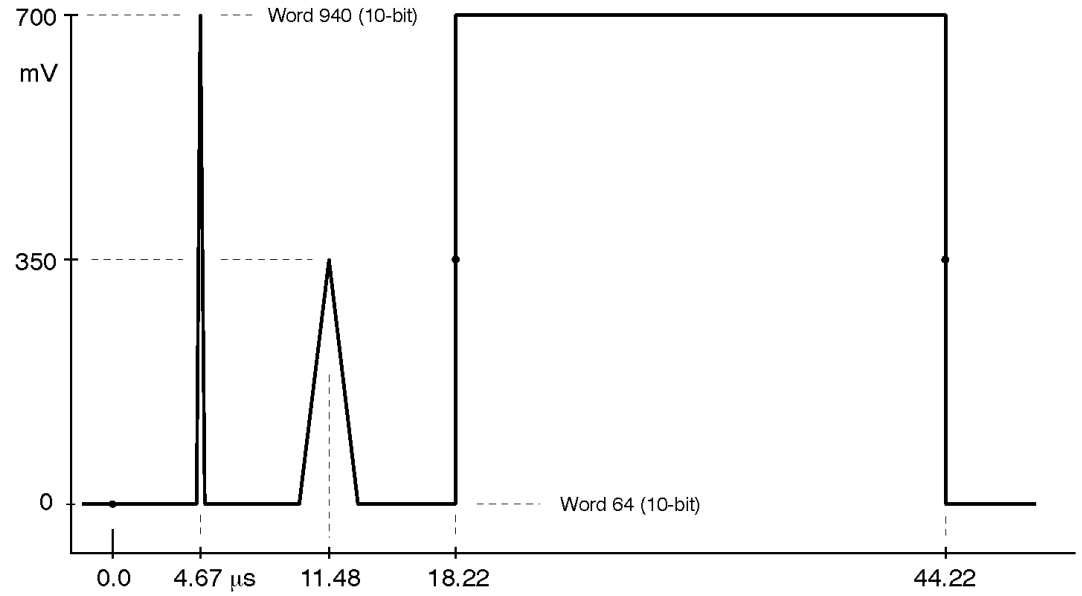


Figure 21: 525 Line Mod Pulse and Bar, Y

Figure 22: 525 Line Mod Pulse and Bar, B–Y

Figure 23: 525 Line Mod Pulse and Bar, R–Y

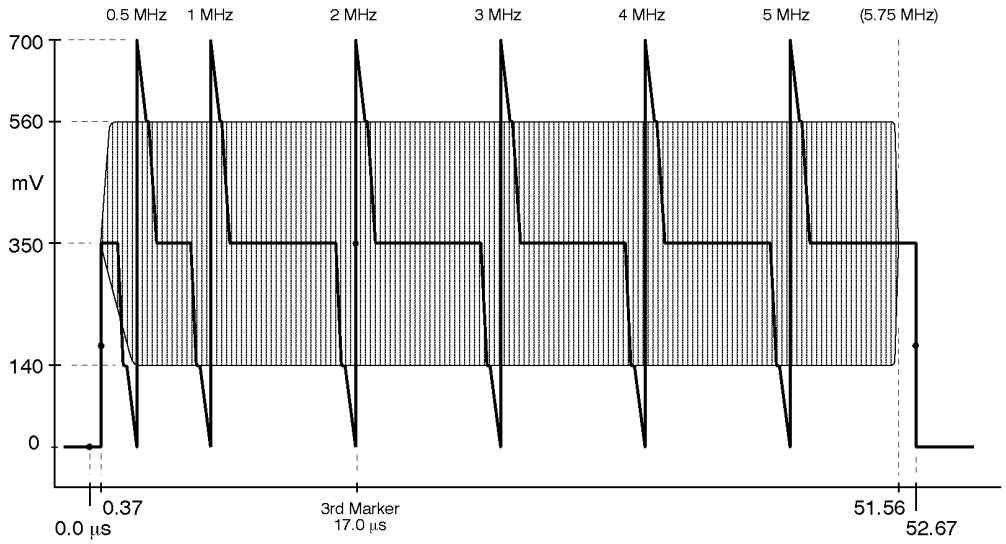


Figure 24: 60% Line Sweep with Markers, Y

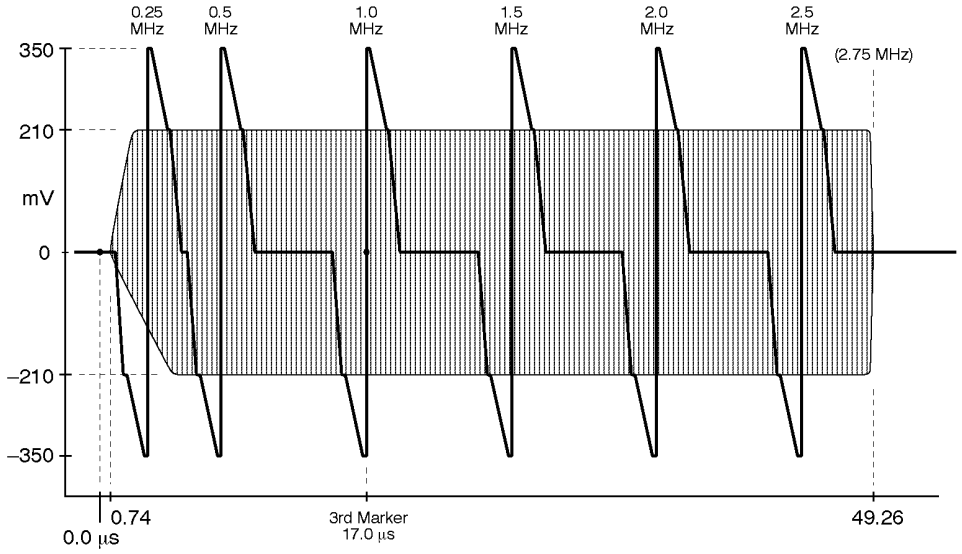


Figure 25: 60% Line Sweep with Markers, B–Y and R–Y

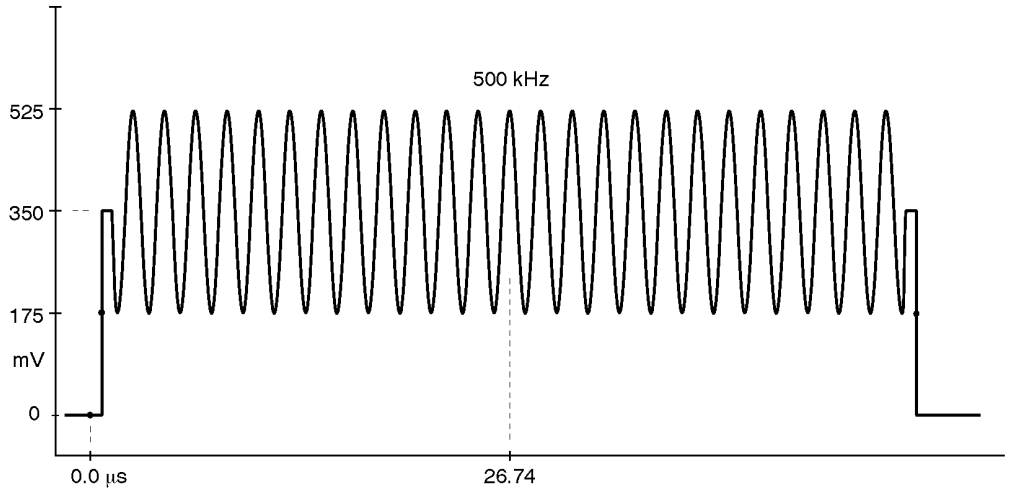


Figure 26: 500 kHz Bowtie (reduced amplitude), Y

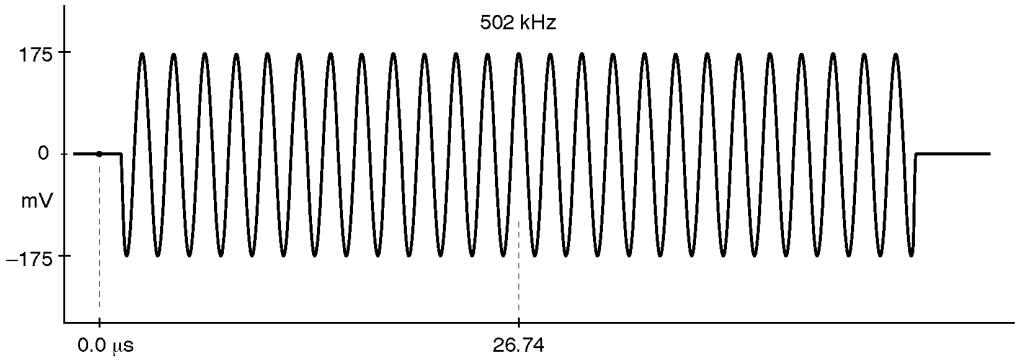


Figure 27: 500 kHz Bowtie (reduced amplitude), B–Y and R–Y

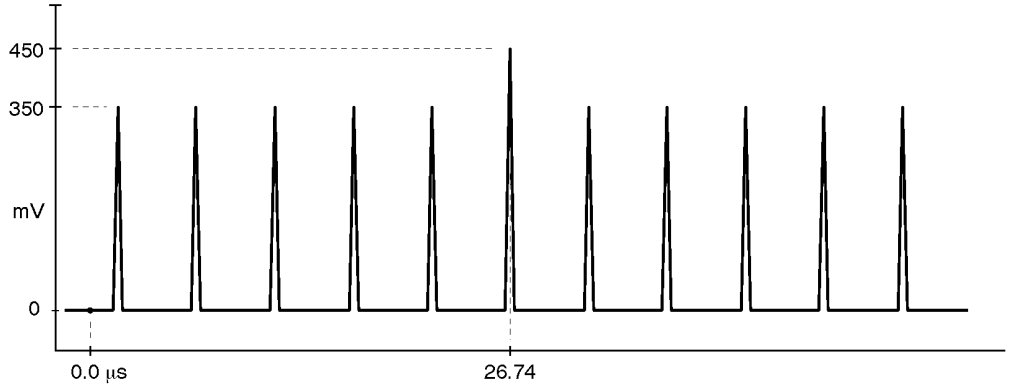


Figure 28: Bowtie Markers, Y channel only

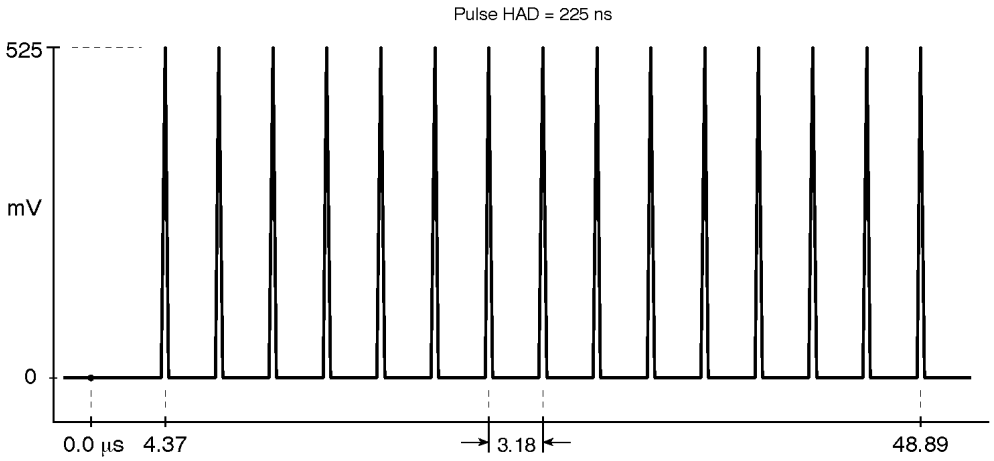


Figure 29: Convergence, Vertical Lines; Y channel only

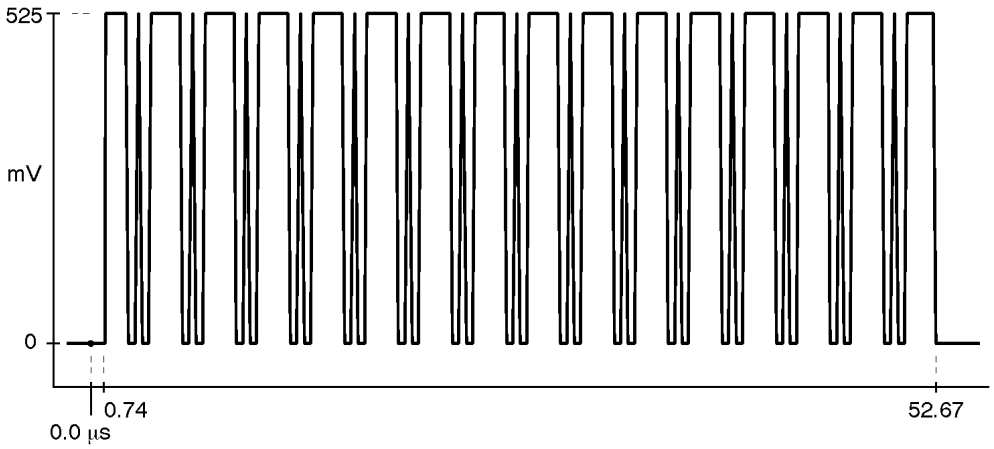


Figure 30: Convergence, Horizontal Lines; Y only

Figure 31: Active Picture Markers, vertical limits, Y channel only

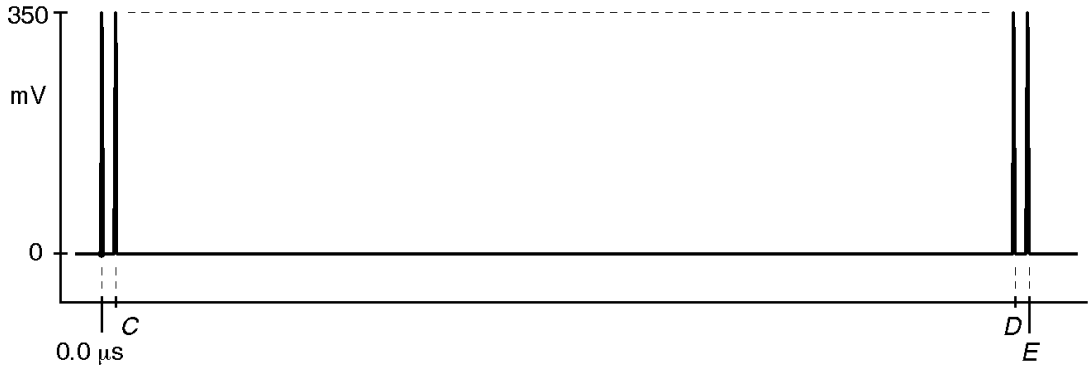


Figure 32: Active Picture Markers, horizontal limits, all channels

Table 15: Active Picture Markers Timing

	A	B	C	D	E
625/50: Y	0.72 µs	52.72	1.04	52.44	53.26
625/50: B, R–Y	(µs)	—	1.04	52.44	53.18
525/60: Y	0.16 µs	53.02	0.29	52.89	53.26
525/60: B, R–Y	(µs)	—	0.29	52.89	53.18

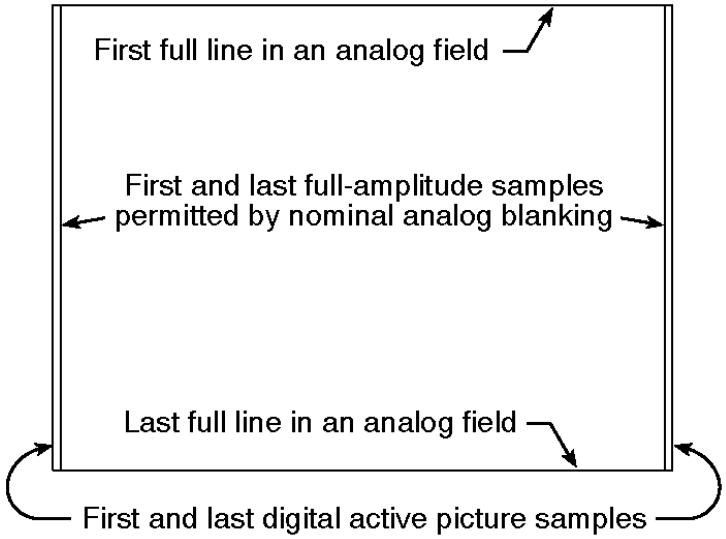


Figure 33: The Significance of the Active Picture Markers

Appendix B: Replaceable Parts

The following Replaceable parts for the TSG 601 are available through your local Tektronix, Inc. field office or representative.

It is important when ordering parts to include the following information in your order: Part number; instrument type and number; instrument serial number; and modification number, if applicable.

Description	Tektronix Part No.
Instructions (card)	070-8909-00
Service Manual (Optional accessory)	070-8911-XX
Rechargeable Battery Pack (Optional accessory)	119-4488-00
Carrying Pouch	016-1229-00
AC Adapter	119-4538-00
Case Assembly, Top	614-0920-00
Case Assembly, Bottom	614-0913-00
Battery Door	200-4075-00
LCD Display	119-4506-00
Rear Panel Assembly	333-4145-00
Fuse, 4A	159-0363-00

Appendix C: User Service

Battery Hints

For optimal battery life and capacity, use the rechargeable NiCad battery pack (Tektronix p/n 119-4488-00) in full charge/discharge cycles. In other words, fully discharge the battery pack before re-charging, and then charge the battery pack until fully charged, approximately 16 hours. A new battery pack will take a few charge/discharge cycles to reach full capacity.

WARNING. *Install or replace batteries only with the instrument switched OFF and the AC adapter disconnected.*

Replace the batteries only with standard AA batteries (1.2–1.5 V, nominal), or with a Tektronix rechargeable battery pack (p/n 119-4488-00).

Setting the Auto Power Down (page 56) and Battery Type (page 57) functions in the diagnostic menu also have an impact on battery life. The battery types are disposable (Alkaline) or rechargeable (NiCad). Setting the battery type changes the voltage thresholds for both the BATTERY LOW display message and low-battery shut down.

The BATTERY LOW Message

The warning “BATTERY LOW” will appear on the second line of the TSG 601 display when the battery voltage drops below a predetermined level. The level depends on the Battery Type set in the diagnostic menu (see page 57). The TSG will operate for approximately ten minutes after the message first appears. For best results, replace or recharge the batteries when you first see this warning.

Low-battery Shut Down

To prevent erratic operation at very low power levels, the TSG 601 will shut itself down if the battery voltage drops below a second, lower threshold that also depends on the Battery Type setting.

Low-battery shut down can happen with little or no warning if, for instance, the instrument has been left on by mistake with Auto Power Down disabled. In such cases, the TSG 601 is likely to shut itself down almost immediately the next time you switch it on. If this happens:

- Install fresh batteries or operate the instrument with the AC adapter, and
- Confirm that the diagnostic menu Battery Type setting is appropriate.

The shut down threshold is higher for rechargeable batteries than for disposable. Therefore, you will receive a false BATTERY LOW message and may experience premature shut down if using Alkaline batteries when the Battery Type is set to “rechargeable.” On the other hand, NiCad batteries may be damaged—they can lose their “rechargeability”—if they are discharged to the TSG 601 threshold for disposable batteries. Be sure to select the correct Battery Type.

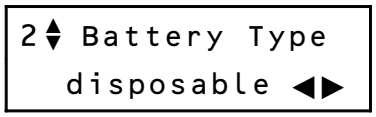
The Diagnostic Menu

To enter the diagnostic menu, hold the Lock Out button down while pressing the ON button. To exit the diagnostic menu and resume normal operation, press any of the rectangular buttons at the top of the keypad.

The diagnostic menu items are listed below. Use the up (▲) and down (▼) arrow keys to scroll up and down the list.

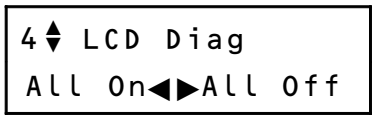
1. Auto power-down; use the left (◀) or right (▶) arrow key to toggle between enabled and disabled.

The Auto Power Down function shuts the TSG 601 off when there has been no key press for approximately 10 minutes, to conserve battery charge. The Auto Power Down symbol (a rotating line) appears in the upper-right corner of the display when the function is enabled.

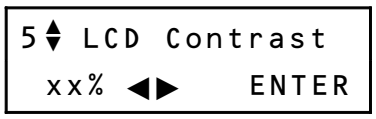


2. Battery type; use the ◀ or ▶ key to toggle between disposable or rechargeable.

3. Factory Reset; press the Enter button to reset the instrument to the factory defaults. *WARNING: All user selections, ID messages, and Presets will be lost.*



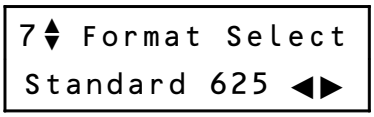
4. LCD Diagnostic; press the ◀ key to turn all segments on, and press the ▶ key to turn all segments off. Exit this diagnostic with the ▲ and ▼ keys as usual.



5. LCD Contrast; use the ◀ and ▶ keys to adjust display contrast to compensate for various viewing angles and ambient lighting.

6. Signal Amplitude Calibrate; please see the TSG 601 Service Manual (p/n 070-8911-XX) for further information.

CAUTION. *Changing this setting will affect the serial video output amplitude and may give unexpected results. This utility should be used by Qualified Service Personnel ONLY.*



7. Format Set; use the ◀ and ▶ keys to select between 625/50 Hz and 525/60 Hz.

8. Software/Signal versions; note these numbers in any correspondence to Tektronix about your TSG 601.

9. Kernel Checksum. This information is used during manufacture and has no pertinence to operation or adjustment of the TSG 601.

10. Xilinx Checksum. This information is used during manufacture.

Preventive Maintenance

Under average conditions, the TSG 601 should receive preventive maintenance every 2000 hours. This is approximately one year of operation. Preventive maintenance includes cleaning, visual inspection, a performance check and, if necessary, calibration. See the Service manual for performance verification and adjustment procedures.

CAUTION. *The TSG 601 case is made of molded plastic. Do not allow water to get inside any enclosed assembly or component. Do not clean any plastic materials with organic cleaning solvents—benzene, toluene, xylene, acetone, or similar compounds—because they may damage the plastic.*