

HORITA PG-2100
Portable SMPTE Time Code Generator
USER MANUAL

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SPECIFICATIONS

CHAPTER 5

1 GENERAL

1.1 Description

The PG-2100 is a small, hand held, battery operated SMPTE (and EBU) longitudinal time code generator. It is intended for portable use in field situations and operates from a single 9 volt battery for over 24 hours. It operates at six different frame rates, and can generate both drop frame and non-drop frame time code.

The PG-2100 can genlock to a video input or can operate in "freerun" mode. When video genlocked, time code drift is tied to that of the drift of the video source. When free running, the PG-2100 is crystal stabilized such that drift rate is not more than one frame per hour at temperature ranges of from freezing to about 120 degrees F.

The PG-2100 can operate in either "Jam Preset" or "Manual" modes. In manual mode, the PG-2100 time code generator can be started and stopped, and also genlocked to a video input.

In Jam Preset Mode, the PG-2100 can preset to and automatically start from an externally applied SMPTE time code input or from the serial time and date from a GPS receiver. Also, while in Jam Mode, specific operation of the PG-2100, such as frame rate selection, can be changed by the user.

1.2 Features

* Generates time code at six frame rates; 23.976, 24, 25, 29.97DF/NDF (Drop Frame)/Non-Drop Frame), and 30FPS (Frames-Per-Second)

* Selectable "LINE" or "MIC" output levels.

- * Includes a selection of common adapters used for inputting and outputting time code, plus a short 18" "RCA-to-RCA" cable.
- * Jams and automatically starts with application of either a time code input or a GPS time or time/date RS232 serial input message
- * Input time code reader frame rate can be different from PG-2100 time code generator frame rate. This allows generating "cross jamming" time code, for example, generating 24 FPS time code from a 29.97 FPS time code input, or vice versa.
- * Video genlock or freerun
- * Operates for 24 hours from a single 9-Volt alkaline battery or for over 12 hrs from a typical 9-Volt rechargeable Nicad battery
- * All setup values are saved in non-volatile memory for instant recall at power up.
- * Presettable "manual" user bit values
- * Four jam modes allow user bits to be jammed or not jammed when the time code is jammed
- * A two character "generator ID" number can be assigned to individual PG-2100 units. The ID number is continuously output in the user bits. In multiple camera situations, this allows tapes recorded with identical time code from several PG-2100 units to be easily identified
- * Low battery voltage detect shows when only a few hours of PG-2100 operation are remaining
- * Small size - only 1-1/4" wide, 3-3/4" long, and 1" thick.
- * Weights less than 5 oz including 9-Volt battery

1.3 Applications

Do you need a dozen inexpensive portable SMPTE time code generators, each preset to a master SMPTE or GPS clock time and date, each supplying time code to a separate audio or video recorder, film camera, or PC, each located at a different location, each with its own identification number, but all operating in exact time code sync?

Perhaps you are intending to perform a two or three camera shoot, such as a local concert, wedding, graduation, or other such event, and you need all your tapes to have the same time code for later editing?

Maybe you are going to record a mountain bike race, car race, boat race, or other sporting event, and you are planning to have many cameras at various locations. Hanging off cliffs, in the air, in the water, in backpacks.

You will want to bring all of the tapes back to the studio after the race is over and produce a complete one hour show.

But how can you get all of the tapes to have the same time code recorded on them? And if they do, how can you tell them apart?

The answer is the HORITA PG-2100.

Use multiple PG-2100s with each having their own individual ID number. Keep a record of the location of where you assign each PG-2100. Then, before the event begins, jam preset all of the units with the SMPTE time code from a HORITA UTG-50 GPS based time code time-of-day/date generator.

Jam presetting is easy, just plug the time code into the PG-2100 and it immediately begins generating matching time/date SMPTE time code. You could also use one of the newer handheld GPS (Global Positioning System) receivers with a compatible RS-232 serial data output to jam preset the PG-2100.

Then, send the PG-2100s off on their way with your recording equipment.

At their destination, directly record the PG-2100 time code output or use it to jam any internal time code generators that may be included within your recording equipment. Since the PG-2100 can generate time code at all of the popular frame rates commonly used for video, audio, and film, their use is flexible and they can be put to use with a large variety of recording equipment and time code formats.

As a side note, you may even want to collect some race data using your PC, and you would like to be sure its time accurately matches that of the event. To do this you could simply use a PG-2100 along with a HORITA PR-232 and the HORITA "PC-LOG" (tm) program.

The PR-232, connected to and powered by the serial port of your computer, translates SMPTE time code into RS-232 serial data. The PC-LOG program installs in your computer and allows you to capture (log) the time code times and add comments, save, print, etc. the log file.

Finally, when you return at the end of the day, all of the tapes will have matching time code, which will also include the date of the event, and each tape with its individual ID number so you can easily tell them apart. None of the tapes will ever have the same ID numbers recorded on them, so you can't get them mixed up. Even when tapes were changed in the field.

Later, when you are editing, you can effortlessly cut between any of the shots and the action will always match.

2 SMPTE TIME CODE

2.1 Introduction

Even if you are already familiar with time code, you may want to review this section.

SMPTE (pronounced "sem-tee") is an acronym for the "Society of Motion Picture and Television Engineers". The SMPTE adopts and sets standards for the motion picture and television industry. SMPTE time code is standardized in two forms: Longitudinal Time Code (LTC or sometimes just TC) and Vertical Interval time code (VITC) pronounced "VIT-C". Because the PG-2100 generates only longitudinal time code, only that is discussed here.

SMPTE LTC time code is an audible timing signal that is used to uniquely identify each frame of a video signal from a camera or other video source. Audible means it can be recorded and played back by audio recorders and that you can hear it through audio systems. If you should hear it, it sounds somewhat like a FAX machine.

Since it is an audio signal, the time code is not recorded in the picture but is instead recorded along with the picture on either an audio channel or on a special time code channel of a VCR, DVD, or other recording device. The time code signal can be recorded when the picture is being recorded, or recorded later during post production (post-recorded), depending on the type of recording equipment.

The "Longitudinal" (sometimes "Linear") part of the LTC name is a carryover from the days when the audio channels on a VCR were such that they recorded the audio signal in tracks along the length of the tape, as compared to the spinning video head(s) recording laterally in strips.

In US television the video frame rate is 30 frames-per-second (FPS). Rather than just counting frames and assigning a number from a long endless linear frame count, the 30FPS frame rate makes it convenient for keeping track of time as well as frame numbers. To do this, SMPTE time code counts each video frame in a frame number, seconds, minutes, and hours fashion and provides a maximum of 24 hours worth of different frame numbers before the numbers start to repeat.

The thirty video frames that occur each second are numbered from 00 to 29 (not 01-to-30), the seconds and minutes are numbered from 00-to-59, and the hours from 00-23. The entire range of possible SMPTE time code numbers is from "00:00:00:00" (midnight) to "23:59:59:29" (one frame before midnight).

The time code signal itself is an 80-bit serial binary code of "1s" and "0s" that repeats once each picture frame, or about 30 times a second for television in the United States. Of these 80 bits, 32 are reserved for the time information. This information consists of eight 4-bit decimal characters, two each for the hours, minutes, seconds, and frames

Another 32-bits of the 80-bits are called user bits and are reserved for adding extra information, such as the date, along with the time information. User bits are made up of eight hexadecimal characters of 4-bits each. A hexadecimal character can have one of 16 values, from 0-to-9 and A through F.

For the PG-2100, the eight user bit characters are numbered 8 7 6 5 4 3 2 1 and, for some modes of PG-2100 operation, are used in pairs to encode the Generator ID number and date into the SMPTE time code. The date is in the form of Year, Month, and Day.

The last 16-bits of the 80-bits of time code form a special "sync" framing pattern that is used to locate and decode the actual time code and user bits of digital information.

When a video source with accompanying time code is viewed on a video monitor, a time code reader can change the audio time code signal back into the actual visible numbers that identify each video frame. These numbers can then be used to locate and select specific video pictures and audio segments to permit precise frame identification for video and audio editing and other purposes.

2.2 29.97FPS Frame Rate and "Drop Frame" Time Code

If you have used time code before, you have probably heard the term "drop frame". If not, eventually you will come across it. Drop frame time code is a special format of SMPTE time code which makes it a more accurate indicator of "real time" and you may want to use it in your system. The following provides a brief description of drop frame time code and may help you determine whether or not to use it.

Present U.S. color television standards were developed to be compatible with earlier black and white television. This required a slight slowing of the video frame rate, from 30 frames-per-second to 29.97 frames-per-second.

Because it's the video frame rate that counts the SMPTE time code clock and the frame rate is a little slow, the SMPTE time code clock falls behind the time on a real clock by about 108 frames an hour, or approximately 3.6 seconds. 3.6 seconds is important to television broadcasters who sell air time, so "drop frame" time code was developed to adjust for this time error and make SMPTE time code time more closely match that of real time.

The "drop frame" technique advances the time code frame count ahead by two frames each minute except on minutes 00, 10, 20, 30, 40, and 50. The six exceptions are because advancing the count by two frames a minute would advance the time by 120 frames in an hour, instead of just 108 frames. This is 12 frames too much (120-108=12). Not advancing on the tens of minutes reduces the amount of advance to the correct amount of 108 frames an hour.

So, at the start of every minute, (except on the tens of minutes), SMPTE drop frame time code advances the time code frame number from 29 to 02, instead of from 29 to 00. Frame numbers 00 and 01 are skipped or "dropped".

Drop frame time code is widely used in all television situations where the video frame rate is 29.97FPS. Use it here or in situations where it is an important requirement that the time code numbers you read from your time coded video or audio sources represent real time to within 3.6 seconds an hour, or 0.6 seconds every 10 minutes.

2.3 23.976, 24FPS, 25FPS, and 30FPS Frame Rates

The PG-2100 also generates time code at frame rates other than 29.97 drop frame and non-drop frame for other applications.

23.976FPS time code is used for optimum compatibility when working with 29.97FPS video and 24FPS film frame rates. The film frame rate of 23.976 is the rate that the 24FPS film frame rate is slowed down to in order to be compatible with the video frame rate of 29.97FPS.

24FPS time code is used for film applications because that is the common frame rate for movie cameras and projectors.

25FPS time code is the frame rate for a number of European (and other) television systems, sometimes referred to as the "PAL" system. Instead of SMPTE, the European standards committee is "EBU" so sometimes the time code is referred to as EBU time code.

30FPS time code provides compatibility with the original frame rate of 30FPS used in the United States for black and white television, and is still used for that and for some audio recording applications.

3 CONNECTING

3.1 Installing and Removing the Battery

NOTE:

Be sure to observe battery polarity. If the battery is installed with the polarity reversed, the PG-2100 will not operate, but no damage will be done.

Slide open and remove the battery compartment cover to install a new 9Volt battery. Install the battery terminal-end first, pushing the battery against the battery clips and case until the battery snaps into the compartment. Install the cover.

To remove the battery, remove the cover and use a small screwdriver or other object to pry the battery out of the compartment, terminal-end first. Alternatively, tap the PG-2100 against a flat surface until the battery comes out. This can usually be done with a single, sharp rap.

3.2 Connecting Time Code or GPS Data IN and Out

To use time code or GPS data to “jam” the PG-2100, connect an RCA cable from the time code output of your reference time code generator, camcorder, VCR, or other time code source device, to the TC I/O SERIAL IN connector on the PG-2100. The PG-2100 can work with time code input levels ranging from 0.5 volts P-P (peak-to-peak) to 10 volts P-P.

If your system uses BNC or XLR connectors for the time code, you will have to use BNC-to-RCA or XLR-to-RCA adapters. The PG-2100 comes with the following adapters:

1. An RCA-to-XLR adapter connects the PG-2100 time code output to an XLR MIC input. This adapter has a female RCA end and a male XLR end. On the XLR end, pins 1 and 3 are grounded and pin 2 is connected to the RCA center pin socket.
2. An RCA-to-BNC adapter permits connecting the PG-2100 to BNC time code ins and outs. The RCA end is female and the BNC end is male.
3. An RCA-to-Mini Phone adapter allows connecting the PG-2100 to various 1/8” MIC/LINE ins and outs. The RCA end is female and the mini phone plug end is male.

Other adapters and connectors are available online or from Horita or from most electronic supply stores, such as Radio Shack or Fry's Electronics.

To jam using GPS RS-232 serial data from a GPS receiver or system, connect it to the PG-2100 TC I/O SERIAL IN connector using an RCA connector. It is typical that you may need to use various RCA, BNC, DB9, or custom cables/adapters to route the GPS data from your GPS receiver to the PG-2100

After the PG-2100 jams to the time code or GPS input signal, it then outputs the SMPTE time code signal at the same TC I/O SERIAL IN RCA connector used to input the jamming signal. Remove the input signal and connect the time code signal now output from the PG-2100 as desired.

3.3 Connecting Video IN

The PG-2100 accepts a video reference for the time code generator if it is desired to genlock the time code output to a video reference. When genlocked, the time code signal does not drift in time or phase relative to the video signal. The genlock reference may be any standard 1V P-P, RS-170 type composite video signal, such as black burst or the composite video output from a camera, VCR, or other source. Connect the output from the video source to the VIDEO IN BNC on the PG-2100.

Note that the PG-2100 does not terminate the video input and although the PG-2100 will operate with an un-terminated video input, for most reliable operation the video reference should be terminated at the PG-2100 if not terminated elsewhere. This can be done by using either a “T” connector and 75 Ohm terminating resistor or an inline 75 Ohm terminator at the PG-2100 VIDEO IN input.

4 OPERATING

4.1 Introduction

We believe that the PG-2100 is easy to use in its most intended application, that of simply being powered ON, jammed (preset) to an external reference time code or GPS input that automatically starts it running, then taken into the field.

However, on closer inspection, you will see that the PG-2100 is actually a sophisticated multi-frame-rate time code generator that offers a lot of flexibility. But with this flexibility comes the opportunity of making mistakes simply because the PG-2100 does not have a time code display readout. The only way for a user to input setup data into the PG-2100 is via actuating a single momentary action switch, and the only means for the PG-2100 to communicate to the user is via signaling using a single red LED.

So, if you need to access more of the features of the PG-2100, we recommend you spend some time reading this section of the manual and operating your unit to become familiar with both its capability and with your needs. To assist with this, a step-by-step tutorial is provided at the end of this section.

The PG-2100 has two primary modes of operation: Manual Mode and Jam Preset Mode.

4.2 Manual Mode Operation

Manual Mode is intended for situations in which you are not interested in recording time code that is related to the time of day and date, or to some other reference time. You simply need a small, portable time code generator to lay down SMPTE time code on a tape or other recording medium.

When you record time code in this fashion, you need to be able to start and stop the time code generator in order to prevent large time "gaps" in the time code. Large time gaps can be troublesome, sometimes causing "cueing" problems, when later editing the tapes.

Therefore, when operating in Manual Mode, the PG-2100 has provision for starting and stopping the time code generator.

To change PG-2100 settings, for example, the frame rate, user bits, etc., when in Manual Mode, the Jam Preset Mode must be selected first, then the values changed, then Manual Mode operation selected.

4.3 Jam Preset Mode Operation

Jam Preset Mode is intended when you need to generate time code that is referenced to and is operating in synchronism with other PG-2100s or other sources of time code or GPS time and date.

Jam Preset Mode is very effective when multiple PG-2100s are jammed from the time-of-day/date SMPTE time code output from the HORITA UTG-50 GPS based time code generator.

Jam Preset Mode is also used to manually set up the PG-2100 frame rate, jam mode, user bits, and generator ID number.

4.4 Operating the Power ON/OFF Switch

A single momentary action Power ON/OFF switch is used to power the PG-2100 ON and OFF, to select the operating mode, and, in combination with a single LED, to read and write various PG-2100 "setup" parameters.

You should note that because there is no human readable display, this will be the most difficult aspect of operating the PG-2100, and will require some practice and patience.

However, once the general method of reading and writing data is learned and understood, you should be able to read and change frame rates, generator ID, or whatever, with certainty and without too much difficulty, using just the reminder label located on the back of the PG-2100.

Before proceeding with a description of operating the PG-2100, a more basic description of switch and LED operation is presented first. After that, power ON and OFF, selecting Manual or Jam Preset operating modes, and then the more involved operations of the PG-2100's switch and LED are described.

The Power ON/OFF switch is a momentary action switch. This means that it doesn't remain in the ON position, but is spring loaded and returns to its original (OFF) position.

Sometimes you will be instructed to "click" the switch. This means you need to quickly, taking less than 1 second, move the switch to the ON position, then release it.

Sometimes you will be instructed to "click and hold" the switch. This means to move the switch to its ON position and hold it there.

It should be noted that operating the switch usually results in some action of the LED. In most cases this action is not immediate but follows a delay of 1 second.

4.5 Understanding Operation of the LED

Because just a single LED is used to interpret what the PG-2100 is doing, it is important to understand how operation of the LED is described in this manual. At times, operation of the LED will be described as "rapid flashing", "slow flashing", a single "flash", etc. These terms are all defined and summarized in the following tables.

4.6 Description of LED Action and Meaning

| LED Action | Meaning |
|-------------------|--|
| Steady ON | The LED is ON continuously. |
| Flash | The LED comes ON once for a short time, then goes OFF for a longer time. |
| Flashing | The LED is alternately going ON and OFF at the same interval. It is ON for the same amount of time that it is OFF. |
| Rapid flashing | The LED is flashing at about 15 times a second, so fast that it appears as a blur of ON and OFF. |
| Quick Flashing | The LED is flashing about four times a second, slow enough to tell ON from OFF. |
| Medium flashing | The LED is flashing about 2 times a second, slow enough to tell ON from OFF. |
| Slow flashing | The LED comes ON for 2 seconds, then goes OFF for 2 seconds. |

Table 4-1, Definition of LED Actions

4.7 Mode of Operation LED Indication

| Mode of Operation | LED Indication |
|---|-------------------------------------|
| Jam Preset Mode Not jammed and no jam input signal applied to Serial I/O | Steady ON |
| Jam Preset Mode Not jammed but LTC or GPS data applied to Serial I/O | Quick flashing, sometimes Steady ON |

Table 4-2, Operating Mode LED Indications

| Mode of Operation | LED Indication |
|--------------------------------------|--|
| Jam Preset Mode-jammed | Single flash at start of each second, extra long flash at start of each minute |
| Jam Preset Mode-jammed and genlocked | Double flash at start of each second and extra long flash at start of each minute. |
| Manual Mode-stopped | Medium flashing |
| Manual Mode-running | Rapid flashing |

Table 4-2 (cont.), Operating Mode LED Indications

4.8 Read/Write Operations LED Indication

| Rd/Wr Operation | LED Indication |
|---------------------------------------|---|
| Data is about to be read back to user | Rapid flashing for 1/2 second |
| Data being "read" back | Flashes the number of single flashes that to user correspond to the numeric value of the data |
| Read data is "0" | Steady OFF |
| Data is about to be "written" by user | Rapid flashing OFF for 1/2 second |
| Time period in which | Steady ON period immediately following data can be "written" 1/2 second of flashing OFF by user |
| Write data is "0" | No switch action while LED is steady ON |

Table 4-3, Read and Change Data LED Indications

4.9 Low Battery Voltage LED Indication

When the battery voltage is low, the LED indicates this by displaying its normal LED operation for 2 seconds, followed by remaining Steady ON for 2 seconds. "Normal" LED operation is that which applies to the particular mode in which the PG-2100 is operating.

4.10 Turning Power ON and OFF

It is easy to turn power ON, and more difficult to turn it OFF. This was done to prevent accidentally powering OFF the PG-2100. It could be quite inconvenient to accidentally power OFF the PG-2100 after it had been earlier jammed to a particular reference time, such as to the time of day, and be operating in a remote location in synchronism with other PG-2100's.

In order to not have descriptions of power ON and OFF scattered around in various sections of this manual, it is discussed here for all of the various operating conditions of the PG-2100, even though those conditions themselves will not be described in detail until later.

4.11 Turning Power ON

When the PG-2100 is first powered ON, the LED immediately comes ON to show application of power. After this, the LED flashes a few times to allow selecting manual mode of operation, followed by steady ON to allow selection of powering the PG-2100 OFF. Finally, the PG-2100 defaults to operating in the Jam Preset Mode, and will automatically power OFF after five minutes if no jam signal is applied to start it.

To turn power ON, click the POWER switch one time. The following sequence of operations occur:

1. The LED comes ON and remains steady ON for 1 second. This is simply to indicate that PG-2100 power is ON.

2. After the 1 second steady ON, the LED flashes at the medium rate for 2 seconds. As described later, this time period provides opportunity to select the manual mode of operation simply by clicking the switch again.
3. After the period of flashing, the LED then remains steady ON for 1 second. The PG-2100 can be powered off during this time by clicking and holding the switch for 1 second. This is described in later paragraphs about power off.
4. Finally, the LED flashes OFF for 1 second, indicating the power off opportunity has passed, then comes ON and remains steady ON. The PG-2100 is now operating in the default Jam Preset Mode and will automatically power off after five minutes if no time code or GPS input signal is applied to cause it to start generating time code.

As later described, the Jam Preset Mode allows the PG-2100 to be preset to a time code or GPS input, and also allows the user to read and enter information into the PG-2100.

The above power ON description can be simplified as follows:

| LED Indication | Meaning |
|---------------------------|--------------------|
| 1. Steady ON 1 second | Powered ON |
| 2. Medium flash 2 seconds | Select Manual Mode |
| 3. Steady ON 1 second | Select OFF |
| 4. Flash OFF, Steady ON | Jam Preset Mode |

4.12 Turning Power OFF

Turning PG-2100 power OFF requires performing a short sequence of operations. This is to help prevent an accidental power OFF.

The exact sequence of operations depends on whether or not the PG-2100 is operating in the Manual Mode or in the Jam Preset Mode, and if operating in the Jam Preset Mode, whether or not it is jammed and is generating time code, or is waiting for an externally applied time code or GPS jam input.

4.13 Power OFF in Jam Preset Mode, Not Jammed

If the PG-2100 has simply been turned ON and the LED is now Steady ON, the PG-2100 is in the default Jam Preset Mode and is not jammed.

To turn power OFF, simply click the power switch one time and note and perform the following steps:

1. After a 1-second delay, the LED flashes at the medium rate for 2 seconds. This gives opportunity to select the manual mode of operation simply by clicking the switch at this time.
2. After manual mode flashing has ended, the LED then comes ON and will remain steady ON for 1 second. During this time click and hold the power switch ON until the LED goes OFF. PG-2100 power is now OFF.

Note that the above two steps are the same as steps 2 and 3 of the power ON sequence. This means that if accidentally powered ON, the PG-2100 can be powered OFF during its power ON sequence simply by holding the power switch ON until the LED extinguishes.

Power OFF Shortcut - If the switch is clicked and held ON during Step-1 when the LED is flashing to select Manual Mode, the PG-2100 will power OFF at the end of the flashing. The only difference is that it will have first entered Manual Mode for 1 second before power went OFF.

4.14 Power OFF in Jam Preset Mode, Jammed

If the PG-2100 has been jammed, selecting Manual Mode is prevented. Clicking the switch one time to turn power OFF skips flashing of the LED to select Manual Mode, and, after the initial 1 second delay, proceeds to where the LED comes Steady ON for 1 second. If the switch is held down during this time, the PG-2100 will power OFF after 1 second.

4.15 Power OFF in Manual Mode

When in Manual Mode, simply clicking and holding the switch ON for 1 second causes the PG-2100 to power OFF.

4.16 Selecting Manual Mode Operation

Manual Mode can be selected either during the power ON or power OFF sequence.

To select Manual Mode at power ON, click the switch 1 time to power up the PG-2100, then click it again when the LED is flashing at the medium rate. The PG-2100 will immediately enter the Manual Mode and start generating time code (the LED continues flashing at the medium rate, indicating the PG-2100 is stopped).

Manual Mode Select Shortcut- The Manual Mode can also be selected at power up simply by holding the switch at power ON, then releasing it as soon as the LED starts flashing at the medium rate.

4.17 Starting and Stopping the Generator in Manual Mode

The purpose of starting and stopping the PG-2100 time code generator is to assist in laying down continuously incrementing time code that does not have large time "gaps" in it. To prevent large gaps when recording time code, the generator needs to be stopped each time tape motion is stopped, then started when recording is again started.

To "start" the generator means to cause it to increment the time code at the selected frame rate. When the generator is "running" the LED flashes rapidly. To "stop" the generator means to "freeze" and hold the time code at its last value. When the generator is "stopped" the LED flashes at the medium rate, about 2 times a second.

After Manual Mode is selected and the LED is flashing at the medium rate, the PG-2100 is generating time code, but it is not counting up at the frame rate. The generator is said to be "stopped".

To start the generator, click the switch again. The LED will begin rapid flashing, indicating that the PG-2100 is "running" and the time code is incrementing. Alternate clicking of the switch will start and stop the time code generator.

4.18 Selecting Jam Preset Mode Operation

Jam Preset Mode of operation is automatically selected as the default mode after power ON, if Manual Mode is not selected.

In Jam Preset Mode, the PG-2100 presets to the input SMPTE time code or GPS RS-232 serial input and automatically starts generating time code.

4.19 Jamming the PG-2100

As previously mentioned, the PG-2100 can jam set to either SMPTE time code or to the RS-232 serial output from a GPS receiver.

There is no special setup required of the PG-2100 to select between SMPTE time code or GPS data for jamming. When a jam signal is applied to the PG-2100 RCA connector marked TC I/O SERIAL IN, the PG-2100 examines the input data and "auto selects" between the various input codes and formats.

4.20 Jamming the User Bits of the Time Code

The user bits of the SMPTE time code can hold 8 characters. When jammed, the PG-2100 user bits can be set to one of four sets of values, depending on the Jam Mode Setup value. These four possibilities are summarized as follows:

All 8 user bit characters can contain exactly the same data that was in the user bits of the jamming time code input.

Six of the user bit characters can be the same as the jamming input, and the remaining two can be set to the Generator ID value.

All of the 8 user bit characters can contain data that was manually preset into the PG-2100.

Six of the user bit characters can contain the data that was manually preset into the PG-2100, and the remaining two can be set to the Generator ID value.

Selecting the correct jam mode is very important in order to insure that you get the date and generator ID into the PG-2100 when that is desired.

4.21 Jam Modes Detailed Description

The following paragraphs present a more detailed description of the four jam modes and the uses of each.

4.22 Jam Mode 0

Jam Mode 0 is useful for jam setting the PG-2100 to a standard LTC input with any mix of user bit values or to a GPS time/date input. Note that the Generator ID is not included in the user bits in Jam Mode 0. At power ON, TC/UB values are all set to zero

Time Code: One time jam to LTC or GPS HH:MM:SS time input which then starts generator.

User Bits: One time jam to LTC user bit values or GPS date values.

4.23 Jam Mode 1

Jam Mode 1 is useful for jam setting the PG-2100 to an LTC or GPS input, such as the LTC from the GPS-MTG which contains both time and date values. In the case of the GPS-MTG, the Generator ID value is inserted into user bits 87 in place of the time zone. At power ON, TC = all zeros; UB = recall of generator ID (UB87) plus zeros for UB65, 43, and 21.

Time Code: Same as Mode-0.

User Bits: One time jam to LTC user bits 65, 43, and 21 data for Year, Month, Day date values, or to GPS data for date. User bits 87 are set to the Generator ID value.

4.24 Jam Mode 2

Jam Mode 2 is useful for jam setting the PG-2100 time to an LTC or GPS input that does not contain the date. In this mode the Generator ID and date can be manually placed into the user bits. At power ON, TC = all zeros, UB = recall of previous manually entered settings.

Time Code: Same as Mode 0

User Bits: User bits are not jammed to LTC user bit or GPS (date) data but are instead set to manually entered hex values from 0-9 and A-F. All manual user bit data is stored in non volatile memory at power OFF and automatically recalled at power ON.

4.25 Jam Mode 3

Like Jam Mode 2, Jam Mode 3 is useful for jam setting the PG-2100 time to an LTC or GPS input that does not contain the date. In this mode the Generator ID and date can be manually placed into the user bits. At power ON, TC = all zeros; UB = Generator ID (UB87) plus recall of manual settings (UB65, 43, 21)

Time Code: Same as mode 0.

User Bits: User bits are not jammed to LTC user bit or GPS (date) data. Instead user bits 65, 43, and 21. are set to manually entered hex values from 0-9 and A-F and user bits 87 are set to the Generator ID value. All manual user bit data is stored in non volatile memory at power OFF and automatically recalled at power ON.

4.26 Jamming to SMPTE Time Code

To jam to an external SMPTE time code signal, connect it to the PG-2100 and the PG-2100 will immediately start generating time code.

As a troubleshooting aid, when the PG-2100 is receiving an LTC input, the LED flashes at the quick rate until the PG-2100 is successfully jammed and starts generating time code.

The frame rate of the input time code can be any of the frame rates at which the PG-2100 operates, from 24 FPS to 30 FPS. The frame rate generated by the PG-2100 will be according to how the PG-2100 is set up. Reading and/or changing the frame rate is discussed in later paragraphs describing setting up the PG-2100.

4.27 LED Indications of Jammed and Genlocked

Once jammed, the PG-2100 LED flashes once per second, with an extra long flash at the start of each minute. If video is applied to the PG-2100, the LED flashes 2 short flashes each second to indicate the PG-2100 is genlocked to the input video.

4.28 Jamming to a GPS RS-232 Serial Input

To jam the PG-2100 from the RS-232 serial data output of a compatible GPS receiver, connect the GPS receiver serial data output signal to the PG-2100. The PG-2100 starts generating time code after 1 to 5 seconds, depending on the timing of the GPS data from the GPS receiver.

As a troubleshooting aid, when the PG-2100 is receiving data from the GPS receiver, the LED flashes at the quick rate until the PG-2100 is successfully jammed and starts generating time code.

4.29 Special Notes About GPS Jamming

GPS receivers usually provide accurate time, position, and velocity outputs. Therefore, most GPS receivers have setup menus to select data output formats to accommodate the many varied needs of different users.

The PG-2100 automatically selects between three standard NMEA 0183 (National Marine Electronics Association) GPS serial data output formats. These are \$GPGGA, \$GPRMC, and \$GPZDA. All of these formats provide time information, while the \$GPRMC and \$GPZDA formats additionally provide date information.

If your GPS receiver outputs more than one of the data messages at the same time, for example \$GPGGA followed \$GPZDA or \$GPRMC, the PG-2100 will pick the \$GPZDA or \$GPRMC message over the \$GPGGA message because it also contains the date, which is not present in the \$GPGGA message.

The GPS time information is used to set the PG-2100 time code generator to the time of day. Note that this will generally be Greenwich Mean Time (GMT), also called UTC (Coordinated Universal Time), unless it has been offset to a local time zone within your GPS receiver.

NOTE:

The time information that is output from your GPS receiver will have a certain amount of latency from UTC, because of the amount of time it takes to output the data. This can be in the order of tens of milliseconds, to several hundred milliseconds (a few tenths of a second), depending on the GPS receiver manufacturer and model number. However, PG-2100 units jammed from the same GPS receiver will usually all have closely matched time code outputs.

Date information is set into the PG-2100's user bit characters. Note that this is optional because the GPS data may or may not contain date information. That is why the user bits in the PG-2100 can be set up in four different ways, as is discussed in earlier paragraphs. Refer to the sections in this manual about Jam Modes for more information.

4.30 The GPS \$GPGGA Data Format

The \$GPGGA format contains the time of day, but does not contain the date. When the PG-2100 jams to the \$GPGGA data, it will not output the date in the user bits of the time code unless they are manually set as later described. Refer to the sections in this manual about Jam Modes for more information.

4.31 The GPS \$GPZDA and \$GPRMC Data Formats

The \$GPGGA and \$GPRMC formats contains both the time of day and the date. When the PG-2100 jams to this date, it outputs the date in the user bits of the time code. Refer to the sections in this manual about Jam Modes for more information.

4.32 Description of Setup Selections

The PG-2100 has ten (10) setup selections consisting power ON-OFF/manual run-stop, and then nine (9) data values that are stored in non-volatile memory. These values can be read or changed. The frame rate and jam mode data values are single digits, the rest of the data, that is the hours, minutes, user bits, and generator ID, are two digits consisting of a tens digit and a units digit. The setup selection is also referred to as the setup code.

4.33 Setup Codes Description

The setup codes are listed in the following table and then described in detail in subsequent paragraphs

| Code | Function | Description |
|-------------|------------------------------|---|
| 1 | Power ON/OFF | Power ON/OFF, select Manual Mode, Manual Run/Stop |
| 2 | Jam Mode | Selects 1 of 4 User Bit Jam Modes |
| 3 | Minutes value | Tens/Units of minutes |
| 4 | Hours value | Tens/Units of hours |
| 5 | UB21 (Day) | Tens/Units manual UB21 (GPS Day) |
| 6 | UB43 (Month) | Tens/Units manual UB43 (GPS Month) |
| 7 | UB65 (Year) | Tens/Units manual UB65 (GPS Year) |
| 8 | UB87 | Tens/Units manual UB87 |
| 9 | Frame Rate | Selects 1 of 6 frame rates |
| 10 | Generator ID | Tens/Units manual Generator ID |
| 11 | MIC/LINE output level select | Selects either a MIC or LINE output level |

Table 4-4, Setup Codes

4.34 Setup Code 1-Power ON/OFF

Previously described.

4.35 Setup Code 2-Jam Mode

Setup Code-2 selects one of four user bit jam operations according to the following table:

| Jam Mode | Time Code and User Bit Jam Operation |
|-----------------|---|
| 0 | TC = jam input, UB = jam input |
| 1 | TC = jam input, UB = ID+jam input |
| 2 | TC = jam input, UB = manual preset |
| 3 | TC = jam input, UB = ID+manual preset |

Table 4-5, User Bit Jam Operation

Refer to paragraph 4-19, "Jamming the PG-2100" for a more detailed descriptions of the four jam modes.

4.36 Setup Code 3-Minutes Value

Setup Code 3 is used to select the minutes value of the time code for reading or presetting. The minutes value is two digits, one for tens of minutes, and one for units of minutes. Valid minutes preset values can range from 00 minutes to 59 minutes.

Minutes preset values are used only in the PG-2100 Manual Mode of operation and are not saved at power OFF. Therefore, they must be set when in the Jam Preset Mode, then the Manual mode must be selected at the power OFF sequence.

4.37 Setup Code 4-Hours Value

Setup Code 4 is used to select the hours value of the time code for reading or presetting. The hours value is two digits, one for tens of hours, and one for units of hours. Valid hours preset values can range from 00 hours to 23 hours.

Hours preset values are used only in the PG-2100 Manual Mode of operation and are not saved at power OFF. Therefore, they must be set up when in the Jam Preset Mode, then the Manual mode must be selected at the power OFF sequence.

4.38 Setup Code 5-UB21 (Day)

Setup Code 5 is used to select the user bit 21 pair of characters for reading or presetting. The user bit 21 characters can have any hexadecimal value of from 0-9 and A-F.

These user bits are referred to as "manual" user bits because their value must be manually entered into the PG-2100. They are saved in the PG-2100 nonvolatile memory at power OFF and recalled at power ON.

When the PG2100 Jam Mode is selection such that the date is to be encoded into the user bits of the time code, user bit pair UB21 is used for the tens and units of the Day.

4.39 Setup Code 6-UB43 (Month)

Setup Code 6 is used to select the user bit 43 pair of characters for reading or presetting. The user bit 43 characters can have any hexadecimal value of from 0-9 and a-f.

These user bits are referred to as "manual" user bits because their value must be manually entered into the PG-2100. They are saved in the PG-2100 nonvolatile memory at power OFF and recalled at power ON.

When the PG2100 Jam Mode is selection such that the date is to be encoded into the user bits of the time code, user bit pair UB43 is used for the tens and units of the Month.

4.40 Setup Code 7-UB65 (Year)

Setup Code 7 is used to select the user bit 65 pair of characters for reading or presetting. The user bit 65 characters can have any hexadecimal value of from 0-9 and A-F.

These user bits are referred to as "manual" user bits because their value must be manually entered into the PG-2100. They are saved in the PG-2100 nonvolatile memory at power OFF and recalled at power ON.

When the PG2100 Jam Mode is selection such that the date is to be encoded into the user bits of the time code, user bit pair UB65 is used for the tens and units of the Year.

4.41 Setup Code 8-UB87

Setup Code 8 is used to select the user bit 87 pair of characters for reading or presetting. The user bit 87 characters can have any hexadecimal value of from 0-9 and a-f.

These user bits are referred to as "manual" user bits because their value must be manually entered into the PG-2100. They are saved in the PG-2100 nonvolatile memory at power OFF and recalled at power ON.

When the Jam Mode is selection 2 or 3, the "Generator ID" value (Setup Code 10) is placed into the user bit pair 87 position of the time code.

4.42 Setup Code 9-Frame Rate

Setup Code 10 is used to select one of six frame rates for reading or changing, according to the following table:

| Value | Frame Rate and Format |
|--------------|---|
| 0 | 29.97 frames per second, non-drop frame |
| 1 | 29.97 frames per second, drop frame |
| 2 | 30 frames per second, non-drop frame |
| 3 | 30 frames per second, drop frame |
| 4 | 24 frames per second (non-drop frame) |
| 5 | 25 frames per second (non-drop frame) |
| 6 | 23.976 frames per second |

Table 4-6, Setup Code Frame Rates

4.43 Setup Code 10-Generator ID

Setup Code-10 is used to select the Generator ID pair of characters for reading or presetting. Like the user bits, the Generator ID characters can have any hexadecimal value of from 0-9 and A-F.

When Jam Modes 1 or 3 are selected, the Generator ID characters are substituted for user bit character pair 87.

NOTE:

Jam Modes 1 and 3 substitute the Generator ID for the manually entered values of user bit pair 87. However, there is no affect on Setup Code 10 for reading or changing the value of user bit pair 87. But, because the generator ID is output in their place for Jam Modes 1 and 3, their value is not present in the time code output of the PG-2100.

4.44 Setup Code 11-MIC/LINE Output Signal Level

Setup code 11 is used to select either a MIC level or a LINE level output signal strength. If the value of setup code 11 is a "0", then the line level output is selected; if it is "1", then the mic level output is selected.

Setup code 11 = 0 = LINE output level. The LINE LEVEL output amplitude is 2.5V P-P. The PG-2100 is set to LINE level output when shipped from Horita.

Setup code 11 = 1 = MIC output level. The MIC output level is about 50mV P-P unloaded, and about 25 mV when plugged into a 600 Ohm MIC input. Although 50mV is a relatively "hot" MIC level, it is still well within the range of manual and automatic level setting attenuators and insures that the high gain MIC input circuits are not overloaded as they are with un-attenuated line level signals.

The PG-2100 is set to LINE level when shipped from Horita.

4.45 Reading and Changing the Setup Data

The PG-2100 allows you to read and change the frame rate, jam mode, hours and minutes preset value (for Manual Mode), the value of all 8 User Bit characters, and the Generator ID number.

You can read or change the Setup information only in the Jam Preset Mode of operation (not in Manual Mode, but you can do it before or after the PG-2100 is jammed).

Because this must be done with just a single switch and LED readout, this will be the most difficult section of both the manual and of operating the PG-2100.

4.46 General Scheme for Reading Setup Data

The general scheme for reading setup data is a two step procedure:

1. The switch is "clicked" the number of times corresponding to a particular Setup selection.
2. The PG-2100 responds by flashing the LED a confirming number of times, followed by flashing a data value for that Setup selection.

4.47 General Scheme for Changing the Setup Data

The general scheme for changing setup data is a three step procedure:

1. The switch is "clicked" the number of times corresponding to a particular Setup selection. The switch is held at the last click.
2. The PG-2100 responds by flashing the LED a confirming number of times, followed by allowing the user to again click the switch to enter a new data value.
3. The PG-2100 responds by again flashing the LED a confirming number of times, followed by flashing the new data value for that Setup selection.

4.48 Tips for Reading and Changing Data

Here are few tips for reading and changing data.

1. Write down the names of the values you are going to read or change.
2. Even if you are just going to change a value, perform a read first and write down its present value.
3. If you are going to change a value, write down its name, its Setup Code, and the new value desired.
4. Pay attention to the Setup Code and value that is automatically read back to you for confirmation after you change it.

4.49 Aborting the Read/Change Cycle

You can immediately abort all Read/Change operations at any time simply by clicking the switch before the operation has finished.

If you realize that you entered a selection of six and you really wanted to enter some other value, simply click the switch at any time to abort.

If you are interested in only the Tens digit of a two digit value, simply click the switch to abort the read operation any time after the Tens digit has been output.

If you want to abort a write operation, all of the above applies, except you cannot abort during those times that you are actually using the switch to enter the changed data.

When the Read/Change cycle is aborted, the LED will return to Steady ON if the PG-2100 is not jammed, or if jammed, return to its 1 pulse per second flash rate.

4.50 Reading Setup Values, Detailed Description

1. Click the switch the number of times corresponding to the desired Setup selection. Refer to the preceding tables for selection for the desired Setup Code.
2. After the switch has been released for 1 second, the PG-2100 responds by first turning the LED OFF for 1/2 second, then by flashing the selected Setup Code for confirmation of correctness. For example, if the switch was clicked 3 times to select Setup Code 3, the LED will flash ON 3 times.
3. After flashing the Setup Code back to the user, the PG-2100 will flash back the values for that code. This is a two step process.
 1. To indicate that the LED is going to flash back a value to the user, the LED first flashes rapidly for 1/2 second, flashing ON from a normally OFF condition. This rapid flashing always means a value is to follow.
 2. Next, the rapid flashing is followed by the LED flashing the number of times corresponding to the value of the Setup selection. If the value is "0" the LED remains OFF.
 3. If there is another digit to follow, for those Setup values that have Tens and Units, the LED again flashes rapidly followed by flashing the Units value.

4.51 Changing Setup Values, Detailed Description

1. Click the switch the number of times corresponding to the desired Setup selection.

However, instead of releasing the switch on the last click, hold switch down for at least 1 second. This will cause the PG-2100 to enter the "Change" mode after flashing the Setup Code selection in Step 2 below.

2. Continue to hold the switch down and after 1 second the PG-2100 responds by first turning the LED OFF for 1/2 second, then by flashing the selected Setup Code for confirmation of correctness. For example, if the switch was clicked 3 times to select Setup Code 3, the LED will flash ON 3 times.
3. After flashing the selected Setup Code back to the user, the LED will remain Steady ON until the switch is released.
4. When the switch is released, the LED flashes rapidly for 1/2 second to indicate entering of a value is to follow.
5. After flashing rapidly, the LED remains Steady ON for 2 seconds to allow time to enter a value for that Setup Code. Each time the switch is clicked the value is counted up by one and the 2 second time limit is restarted.

NOTE:

Attempting to enter invalid values, for example, a minutes preset value greater than 59, or a Jam Mode value greater than 3, will abort the entire change operation.

To enter a value of "0", don't perform any switch clicks.

When finished entering data stop clicking the switch.

After 2 seconds of no activity and, if there is a second (Units) digit to enter, the LED again flashes rapidly to signal entry of the next digit. Operation repeats as previously described.

6. After the only digit or last digit is entered, the PG-2100 automatically enters Read mode and flashes back to user the selected Setup code and values entered.

Again note that if no data is entered when the LED is ON, the value is set to "0" for that digit. If only one digit is to be changed, and the other is to be left the same, perform a Read operation first and note the value of the digit that needs to be reentered and the re-enter it when changing the data.

4.52 Tutorials

The following paragraphs provide quick tutorials on how to power the PG-2100 ON and OFF and how to select, read, and change Setup values.

4.53 Power ON/OFF, Jam Preset Mode

Perform the following steps and observations to power the PG2100 ON and OFF in Jam Preset Mode.

1. With PG-2100 power OFF, click the switch one time
Observe: LED comes Steady ON for 1 second
LED flashes for 2 seconds
LED stays Steady ON for 1 second
LED flashes OFF one time
LED stays Steady ON
2. Click the switch one time again
Observe: LED goes OFF after 1 second
LED stays OFF for 1/2 second
LED starts flashing
3. As soon as the LED stops flashing (2 seconds) and comes Steady ON, click and hold the switch until the LED goes OFF. The PG-2100 is now powered OFF.

4.54 Power ON/OFF, Manual Mode

Perform the following steps and observations to power the PG2100 ON and OFF in Manual Mode.

1. With PG-2100 power OFF, click the switch one time
Observe: LED comes Steady ON for 1 second
LED starts flashing
2. As soon as the LED starts flashing, click the switch one time
Observe: LED continues flashing. PG-2100 is now in Manual Mode and is "stopped".
3. You may click the switch several times to start and stop the PG-2100 in the Manual Mode if desired. When done, click and hold the switch until the LED goes OFF. The PG-2100 is now powered OFF

4.55 Read and Change Setup Data

Perform the following steps and observations to read and change PG-2100 Setup information.

4.56 Read Minutes Value

1. If not already powered up, power up the PG-2100 in Jam Preset Mode as previously described.
2. Click switch 3 times to select Setup Code 3 for Minutes value

3. Wait 1 second
 - Observe: LED goes OFF for 1/2 second
 - LED flashes 3 times, confirming setup Code 4 selected
 - LED flashes rapidly for 1 second
 - LED is either steady OFF or flashes from 1 to 5 times. This is the value of the tens of minutes
 - LED flashes rapidly for 1 second
 - LED is either steady OFF or flashes from 1 to 9 times. This is the value of the Units of minutes
 - LED comes ON and remains steady ON

4.57 Change Minutes Value

The following tutorial will change the minutes value to 25 minutes, then to 00 minutes.

4.58 Change Minutes Value to 25 Minutes

1. If not already powered up, power up the PG-2100 in Jam Preset Mode as previously described.
2. Click switch 3 times to select Setup Code 3 for Minutes value. Hold switch down on last click.
3. Wait 1 second
 - Observe: LED goes OFF for 1/2 second
 - LED flashes 3 times
 - LED comes ON and remains steady ON
4. Release switch
 - Observe: LED flashes rapidly for 1 second
5. When LED finishes flashing rapidly and comes Steady ON, click switch 2 times. This enters tens of minutes value of 2
6. After 2 seconds of no switch activity Observe: LED flashes rapidly for 1 second
7. When LED finishes flashing rapidly and comes Steady ON, click switch 5 times. This enters tens of minutes value of 5
8. After 2 seconds of no switch activity PG-2100 reads back the minutes value entered.
 - Observe: LED goes OFF for 1/2 second
 - LED flashes 3 times, confirming Setup Code 3 selected
 - LED flashes rapidly for 1 second
 - LED is either steady OFF or flashes from 1 to 5 times. This is the value of the tens of minutes
 - LED flashes rapidly for 1 second
 - LED is either steady OFF or flashes from 1 to 9 times. This is the value of the Units of minutes
 - LED comes ON and remains steady ON

4.59 Change Minutes Value to 00 Minutes

1. Click switch 3 times to select Setup Code 3 for Minutes value. Hold switch down on last click.
2. Wait 1 second
 - Observe: LED goes OFF for 1/2 second
 - LED flashes 3 times
 - LED comes ON and remains steady ON
3. Release switch
 - Observe: LED flashes rapidly for 1 second
4. When LED finishes flashing rapidly and comes Steady ON, do nothing. This enters a tens of minutes value of zero
5. After 2 seconds of no switch activity
 - Observe: LED flashes rapidly for 1 second

6. When LED finishes flashing rapidly and comes Steady ON, do nothing. This enters tens of minutes value of zero
7. After 2 seconds of no switch activity PG-2100 reads back the minutes value entered.
 - Observe: LED goes OFF for 1/2 second
 - LED flashes 3 times confirming Setup Code3 selected
 - LED flashes rapidly for 1 second
 - LED is steady OFF for 1 second - This is the zero value for the tens of minutes
 - LED flashes rapidly for 1 second
 - LED is steady OFF for 1-second - This is the zero for the units of minutes
 - LED comes ON and remains steady ON

This is the end of the tutorials.

5 SPECIFICATIONS

Power

Operation 9 Volt DC battery
 Battery Life Approximately 24 hours from Alkaline battery, 4-6 hours from rechargeable Nicad, depending on battery capacity.

Video

Input 1 Volt P-P, standard NTSC RS-170 for genlocking 29.97 FPS frame rates, or PAL 625/50Hz composite video for genlocking 25 FPS frame rate.
 Connector BNC

Time Code

Format SMPTE time code format running at frame rates of 23.976, 24, 25, 29.97DF, 29.97/30 NDF, or 30FPS
 Input Level 200mv to 5V P-P (approximately - 15dBV to +8dBu)
 Impedance 10K Ohms (approx)
 Output Level LINE level - approximately 2.5 V P-P (-2dBV/0.22dBu) square wave
 MIC level - approximately -35dBV/-33dBu (50mV P-P) square wave, 10K load approximately -38dBV/-36dBu (35mV P-P) square wave, 1K load
 Connector RCA
 Stability Not more than +/-1-frame per hour over operating temperature range

GPS

Input Level RS-232 or TTL
 Formats NMEA V0183 \$GPGGA, \$GPZDA, \$GPRMC
 Baud Rate 4800 baud, 8 bits, no parity, 1 stop
 Connector RCA (same one as used for time code)

Switches

Momentary toggle for power ON/OFF and setup

Indicators

Red LED for power, setup, and operation

Environment

Operating 32F to 120F (0C to 49C)
 Storage 14F to 140F (-10C to 60C)

Size

1-1/4" wide, 3-3/4" long, 1" thick

Weight

5 oz, including battery

Specifications subject to change without notice