

Horita PTG2

Portable SMPTE Time Code Generator/Reader

With 2 Line OLED Display

23.976, 24, 25, 29.97DF, 29.97NDF, and 30 FPS, SD/HD Compatible

User Manual

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HORITA[®]

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1 GENERAL

This manual provides instructions for operating the Horita PTG2 Portable Time Code Generator. Intended for portable use in the field, the Horita PTG2 is a low cost, palm-sized, battery operated miniature SMPTE time code generator/reader. The PTG2 has a bright 2 line yellow colored OLED display which shows time code and user bit values as well as PTG2 setup information.

SMPTE time code is commonly referred to as TC or LTC. LTC stands for Longitudinal/Linear Time Code. When generating time code the PTG2 can be manually preset and then operated in a switch actuated “run/stop” mode, or it can be set to automatically “jam” (preset) to an externally applied TC signal or to the time and date information from a GPS receiver and continue generating time code numbers from that point.

SECTION 5 of this manual includes a dictionary of definitions for the acronyms and abbreviations used in this manual, along with a description of SMPTE time code.

2 FEATURES

- Reads and generates SMPTE time code at six frame rates of 23.976, 24, 25, 29.97DF (Drop Frame), 29.97NDF (Non-Drop Frame) and 30 FPS.
- Compatible with HD frame rates of 50/720P, 50/1080i, 59.94/720P, and 59.94/1080i
- The time code generator can genlock to SD composite video (bi-level) or to HD tri-level sync signals.
- Time code generator “auto jam” mode presets the generator to TC time or to GPS time/date serial data input. Once jammed, generator operation continues and can be stopped only by powering the PTG2 off, preventing accidental stopping of the generator via unintended actuation of the “run/stop” switch.
- Low generator "free run" maximum drift rate of one-frame per hour over full temperature range.
- GPS jam mode can automatically select from three different GPS NMEA message input formats.
- Frame rate of generator output does not have to match that of TC reader jam input frame rate (“cross jam”).
- "Manual" generator mode allows user to operate PTG2 manually using front panel “run/stop” switch.
- Menu selectable MIC or LINE level time code generator output levels.
- Time code reader mode displays time code, user bits, and frame rate values when reading time code, or time and date values when reading GPS NMEA serial data.
- Time code reader measures and displays the actual frame rate to tell user if reading 23.976 FPS or 24 FPS time code, or if reading 29.97 FPS or 30FPS time code
- Simple to use setup menus for time code, user bits, and system mode are easy to understand, and all setup information is permanently stored in a non-volatile EEPROM memory, even when the battery is removed.
- Bright, yellow colored 2 line x 16 character OLED display shows time code, user bits, frame rate, setup information, and genlock and low-battery conditions.
- To conserve battery power the PTG2 features selectable display shutdown options, auto power off after 15 minutes if not reading time code when in reader or auto jam mode, and a user settable auto power off after 1 to 8 hours of generator operation.
- Powered by a 9 volt Alkaline 540 mAH battery the PTG2 operates for over 11 hours with the 2 line display continuously ON, or for over 17 hours with display set for auto OFF/ON operation. Other 9 volt batteries may operate the PTG2 more or less time, depending on the mAH rating of the battery.

3 GETTING STARTED

3.1 Installing and Removing the Battery

To install or remove the 9-Volt battery first slide open and remove the battery compartment cover. Be sure to observe battery polarity. If the battery is installed with the polarity reversed the PTG2 will not operate, however no damage will be done.

Battery Compartment With Internal Clips - To remove the battery place a small screwdriver or other object between the bottom of the battery and the case and push the bottom of the battery towards the battery clips just enough to free the bottom of the battery from the case and allow it to slide up and out bottom end first.

To install the battery place it terminal-end first against the battery clips and push it to compress the clips until the bottom of the battery snaps into the compartment. Install the cover.

Battery Compartment With 9V Battery Clip - Remove the battery from the compartment and remove the clip from the battery. To install a new battery attach the clip to the new battery and place it into the compartment with the battery clip at the where the wire enters into the compartment. Make sure the service loop of wire is placed between the battery and the inside wall of the compartment and none is under the battery. If the service loop is between the battery and the outside wall it will be difficult to slide the cover off because the battery will prevent the center snap latch from being pushed down to disengage the cover from the case.

3.2 Connecting Time Code or GPS Serial Data IN

A BNC connector labeled TC I/O-GPS IN serves for both input and output of time code as well as for input of RS232 serial data from a GPS receiver.

To read time code or GPS data for display or to jam the time code generator, connect a cable from your signal source to the PTG2 "TC I/O GPS IN" connector. Various adapters are included with the PTG2 to facilitate doing this.

The amplitude of the time code input should be a line level signal of at least 0.5V P-P. The GPS signal level can be at 0/5V logic levels or +/-V RS-232 levels.

3.3 Connecting Time Code OUT

The PTG2 outputs time code on the TC I/O GPS IN connector. Either a LINE or MIC (microphone) output level can be selected via the SYS SETUP menu, as described in later paragraphs. Various adapters are included with the PTG2 to facilitate doing this.

3.4 Connecting Video/Sync Genlock Reference IN

To genlock the PTG2 time code generator to an external video/sync reference, connect the reference source to the PTG2 GLK REF IN connector. Note that the PTG2 terminates the reference input at 75 Ohms. The PTG2 accepts standard 1VP-P NTSC 525/29.97 or PAL 625/25 composite video (bi-level), or HD tri-level sync signals for use as the genlock reference.

3.5 Quick Review Of What to Set Up On The PTG2

If you have used the PTG2 earlier and are going to use it again for the same application or situation, then simply power it up and go.

If starting from the beginning, then you will need to configure PTG2 operation for your needs. If using the PTG2 as a SMPTE time code generator you will want to set the generator FPS rate, output level, user bits source, and select the generator operating mode as either manual or autojam. If the user bits source is to be from manually entered values, such as for the date, production number, etc., then you will want to set those values before generating time code.

If using the PTG2 simply as a SMPTE time code reader or GPS time/date display, then all that is necessary is to select the "RDR TCR/GPS" mode and connect the desired input signal.

The following paragraphs provide instructions for using the PTG2's menu system to select options and presets to configure it for optimum operation in specific time code generating and reading situations, followed by instructions and information for using the PTG2 to generate or read time code.

3.6 Power ON/OFF

A single momentary action miniature toggle switch with a center OFF position is labeled SEL,ON and SET,R/S and is used to power up the PTG2 and also to operate it. When the PTG2 is powered off, momentary actuation of the switch to the ON position powers up the PTG2. The PTG2 is powered off by selecting "PWR_OFF" in the Main Setup Menu as described in later paragraphs.

3.7 Automatic Power Off

The PTG2 automatically powers off after about 15 minutes if no time code is applied or if the generator is not started. This is to save battery life should the unit accidentally be left on. Also, when in the generator mode, the PTG2 can be set in one-hour increments to automatically power off after operating for 1 to 8 hours.

3.8 Indicators And Displays

The PTG2 has a single red LED to show power ON as well as other operating status, and an OLED display to show various text and numeric values.

3.9 LED Operating Status Indicator

The red LED indicates power ON as well as the operational status of the PTG2 when reading or generating time code. This is summarized in the following table:

LED Indication	Meaning
OFF	Power is OFF
Steady ON	Power is ON, in GEN AUTOJAM mode or in RDR TCR/GPS mode with no signal activity on the TC I/O GPS IN input.
Random flash ON/OFF	In GEN AUTOJAM or RDR TCR/GPS mode with signal activity on the TC I/O GPS IN input.
1/2 sec flash ON/OFF	In GEN MAN R/S mode and generator is "stopped"
Frame rate flash ON/OFF	In GEN MAN R/S mode and generator is "running" or in RDR TCR mode and reading time code
1PPS flash OFF	In RDR GPS mode and reading GPS NMEA data
1PPS flash ON	In GEN AUTOJAM mode, generator is jammed and is running
1PPS double flash ON	In GEN AUTOJAM mode, generator is jammed, running, and is genlocked.

3.10 OLED Display

The PTG2 OLED display is organized as 2 lines of 16 characters each. The low-power display has a pleasing yellow color and needs no "back light" to illuminate the characters because it is an LED device. In addition, there are several "power savings" modes of operation to increase PTG2 battery life.

When reading and generating time code the first line (Line-1) of the display shows the time code value and the second line (Line-2) the frame rate and the user bit values. In the SETUP mode the OLED displays the various options and settings available.

An example of a typical OLED display when the PTG2 is generating time code is shown below:

OLED Display	Description
GEN: HH:MM:SS:FF	Generator mode, HH:MM:SS:FF = TC time value (";" = drop frame time code)
29DF UU:UU:UU:UU	Frame rate = 29.97 FPS drop frame, UU:UU:UU:UU = TC user bit values

3.11 Low Battery Indicator

When there are only a few hours of battery life remaining, Line-2 of the OLED display alternates at one-half second intervals between displaying the FPS rate and the message "BATT" as shown below:

OLED Display	Description
GEN: HH:MM:SS:FF	Generator mode, HH:MM:SS:FF = TC time value (";" = drop frame time code)
BATT UU:UU:UU:UU	BATT = Low battery voltage, UU:UU:UU:UU = TC user bit values

4 OPERATON

The PTG2 has three modes of operation; generator mode (TCG), reader mode (RDR), and SETUP mode. In generator mode the PTG2 can generate SMPTE time code that matches that of a time code input to the PTG2 or it can generate time code that starts from values manually entered by the user.

In RDR mode the PTG2 can read either SMPTE time code and user bits (TCR) or GPS time/date messages (GPS).

In SETUP mode the user can select and change the operating mode of the PTG2 as well as other parameters of PTG2 operation.

Because SETUP mode is used for both Generator and Reader operation it is described first. However, if you are already familiar with the SETUP mode and menus then you can proceed to later paragraphs describing the Generator and Reader modes of operation.

4.1 SETUP Mode Operation

SETUP mode allows operation of the PTG2 to be changed between reader and generator modes, change the generator frame rate, presets, etc.

4.2 Entering SETUP Mode

To enter the Setup mode hold the switch in the SEL position for approximately 1 second until a setup menu is displayed. The Main Setup menu is indicated by the word "SETUP" as the first word on Line-1. If the Main Setup menu is not displayed, then continue to actuate the SEL switch until it is.

The SETUP menu is accompanied by a flashing character located at the start of one of the selectable menu items. The flashing character is referred to as the "cursor" and actuation of the SEL switch moves the cursor to the right from one menu item to the next. Actuation of the SET switch then selects the flashing main SETUP menu item and a new "sub" menu shows the selections available for that main SETUP menu selection.

4.3 Selecting And Changing a Setup Menu Item

When a "Sub-Menu" is selected from the Main SETUP Menu, further actuation of SEL moves the cursor through the items in the sub-menu that can be changed. This action continues until the system returns back to the Main SETUP menu and to the sub-menu item that was previously selected.

When in a sub-menu and SET is actuated, that causes the selected item to change to the next available value; numbers are counted up, selections or options move to the next one.

4.4 Exiting SETUP Mode

The SETUP mode is exited in the same manner as it was entered, by holding the switch in SEL for about 1 second. Whenever SETUP mode is again entered it will return to this same menu item unless it has been in operate mode for approximately 2 minutes, in which case it returns to the main SETUP menu.

To get back to the main SETUP menu if in a sub-menu, actuate the SEL switch to go thru each sub-menu item until back at the main SETUP menu.

When SETUP information is changed it is stored in an EEPROM memory and recalled each time the PTG2 is powered up. This action always restores PTG2 operation and settings to what they were when the PTG2 was last powered off. The EEPROM memory retains the stored information without needing battery power.

4.5 Main SETUP Menu

The Main Setup Menu provides selection of various sub-menus to configure PTG2 operation. The following selections are available on the Main Setup Menu:

<u>Main SETUP Menu Display</u>	<u>Description - Sub-Menus</u>
SETUP: SYS TC UB	SYSTEM, TIME CODE, USER BITS
BAT_SAVE PWR_OFF	BATTERY SAVE, POWER OFF

Main SETUP Menu Selections	Description
SYS	Selects the "System" sub-menu
TC	Selects the "Time Code" sub-menu
UB	Selects the "User Bits" sub-menu
BAT_SAVE	Selects the "Battery Power Save" sub-menu
PWR_OFF	Selects "Power OFF"

4.6 "SYS" Setup Sub-Menu

The System Sub-Menu allows configuration of the PTG2's mode of operation and time code output level.

Example SYS Sub-Menu Display	Description
MODE:GEN AUTOJAM	PTG2 operating mode
LEVEL OUT:LINE	Output level

SYS Sub-Menu Selections	Description
MODE:RDR TCR/GPS	"Reader" mode - PTG2 looks for either SMPTE time code or GPS NMEA time/date signal on the TC I/O GPS IN input.
MODE:GEN AUTOJAM	Generator auto jam mode presets generator to TC or GPS data input values and outputs TC and UB values according to various time code and user bit sub-menu selections.
MODE:GEN MAN R/S	Generator manual Run/Stop mode. Actuation of the R/S switch alternately starts and stops incrementing of the time code value. Initial TC/UB values are from the time code and user bit presets.
LEVEL OUT:LINE	Selects line level time code output of approximately 2.5V P-P (-1dBV)
LEVEL OUT:MIC	Selects microphone level time code output of approximately 0.050V P-P (-35dBV). This MIC level is slightly high as compared to the output from a typical microphone. This is because it is an unbalanced signal in a relatively noisy environment. However, it is still well within the range of either automatic or manual microphone input level adjustment and therefore will not "swamp" microphone input circuits as an un-attenuated LINE level signal will.

4.7 "TC" Setup Sub-Menu

The Time Code Sub-Menu allows the user to select the FPS frame rate of the time code generator output and to preset the time code generator starting value (when in manual generator mode).

Typical TC Sub-Menu Display	Description
FPS: 29.97DF	TCG FPS rate
PRE: 12:00:00:00	TCG preset value

TC Sub-Menu Selections	Description
FPS: 23.976F	23.976 FPS
24F	24 FPS
25F	25 FPS
29.97DF	29.97 FPS Drop Frame
29.97NDF	29.97 FPS Non-Drop Frame
30F	30 FPS
50/720P	25 FPS (HD)
50/1080I	25 FPS (HD)
59.94/720P	29.97 FPS drop frame (HD)
59.94/1080I	29.97 FPS drop frame (HD)

PRE: HH:MM:SS:FF Provides preset of time code values from 00:00:00:00 to 23:59:59:29

4.8 "UB" Setup Sub-Menu

The User Bit Sub-Menu allows the user to preset the user bits and to select the user bit data that will be output when the generator is jammed.

The user bits consist of eight (8) hexadecimal characters generally numbered in pairs from 8-to-1, left to right (87:65:43:21), and although each character is made up of four (4) actual binary bits, the characters are referred to simply as the "user bits" of the time code. Each user bit character can individually be set any value in the range of "00" to "FF" of the hexadecimal numbering system. If desired, on the PTG2 an ID number can be separately assigned to user bits 8 and 7 and the remainder used for some other purpose, such as the date to identify footage from multi-camera productions.

The User Bits Sub-Menu is described below:

UB Sub-Menu Selections	Description
UB: ALL RDR RDR: RR:RR:RR:RR	TCR/GPS reader data is the source of all generator UB data "R" is the TCR/GPS reader UB character data output value
UB: ALL MAN MAN: MM:MM:MM:MM	Manually entered UB preset data is the source of all generator UB data "M" is the manually entered UB preset data output value for each of the 8 user bit characters; 87:65:43:21
UB: ALL 00 00:00:00:00:00	UB data is to be all zeros UB all zero data output value
UB: ID + RDR ID: ID + RR:RR:RR	UB data consist of the 2 char PTG2 ID plus the RDR UBs 65:43:21 ID+RDR UB data output value

4.9 "BAT_SAVE" Setup Sub-Menu

The BAT_SAVE sub-menu provides two functions, "DSP PWR SAV" and "AUT PWR OFF" to increase battery life and operating time of the PTG2.

The "DSP PWR SAV" function reduces the amount of information displayed by the OLED after the generator has been running for a few seconds. However, whenever SEL or SET is actuated, any BAT_SAVE selection that had turned all or part of the display OFF is nullified and the full display is immediately turned ON.

The "AUT PWR OFF" function is a timer that switches PTG2 power OFF after a delay of 1 to 8 hours of generator operation. It's easy to forget to turn the PTG2 OFF. so, if you know you are going to be using the PTG2 for only a few hours, then this function will turn the PTG2 off after the selected amount of time has elapsed, preventing it from running should it be forgotten to turn it off.

BAT_SAVE Menu Selection	Description	Approx Operating Time
DSP PWR SAV: NO	Power save function is turned off.	12 Hours
TC	Set to show Line-1 TC only, no other data.	14 Hours
FRM	Set to show just TC frames, no other data.	17 Hours
BLK	Set to go black. No data is displayed.	18 Hours
AUT PWR OFF: NO	The GEN automatic power OFF option is disabled .	
1HR - 8HR	The generator will automatically power OFF after 1 to 8 hours of operation.	

NOTE:

The auto off timer is active only in the generator mode of PTG2 operation. It is turned off each time the PTG2 is powered off and needs to be reset each time the PTG2 is powered up if it is desired to be used. This is to prevent the PTG2 from unexpectedly powering off while actively being used because of a forgotten or unknown prior setting of the timer.

4.10 "PWR_OFF"

The PWR_OFF selection has no actual menu but instead turns PTG2 power OFF. To do this simply actuate and hold the SET switch for 1 second until the PTG2 powers OFF. When PWR_OFF is selected it changes to YES_OFF until the PTG2 powers OFF.

4.11 Generator Modes

When first powered up the PTG2 starts in either the GEN AUTOJAM, GEN MAN R/S, or RDR TCR/GPS mode. The RDR TCR/GPS mode is discussed in later paragraphs.

In GEN AUTOJAM mode time code (or GPS NMEA data) applied to the TC I/O connector jams the PTG2 to that time code value and the PTG2 then outputs new time code on that same TC I/O connector.

In GEN MAN R/S mode the PTG2 starts generating time code but it is "frozen" at all zeros until the R/S switch is actuated to start the time code incrementing.

A typical OLED display for either of the generator modes is shown below:

OLED Display	Description
GEN HH:MM:SS;FF	Generator mode, HH:MM:SS;FF = TC time value (";" = drop frame time code)
29DF UU:UU:UU:UU	Frame rate = 29.97 FPS drop frame, UU:UU:UU:UU = TC user bit values

Because of the fewer character places available for the FPS display, the following table provides the actual FPS rate for each abbreviated FPS value displayed on the generator operating display:

GEN FPS Value Displayed	Actual Time Code FPS
23.9	23.976 FPS
24F	24 FPS
25F	25 FPS
29DF	29.97 FPS Drop Frame
29ND	29.97 FPS Non-Drop Frame
30F	30 FPS
50P	25 FPS for 50/720P FPS HD video
50I	25 FPS for 50/1080I FPS HD video
59P	29.97 FPS DF for 59.94/720P FPS HD video
59I	29.97 FPS DF for 59.94/1080I FPS HD video

4.12 "GEN MAN R/S" Mode

When in GEN MAN R/S mode the time code generator is started and stopped by alternately "clicking" the switch to the R/S position. The PTG2 generates time code according to the setup menu selections for the frame rate and any preset values for the time code or user bit fields.

When the generator is running the LED blinks ON and OFF at the frame rate. When the generator is stopped both the LED and the colon separators in the OLED time code display blink ON and OFF at a 1/2 second rate.

4.13 Presetting the Generator Time Code and/or User Bits

In the manual R/S mode the generator's time code and/or user bits can be set to zero or to preset values previously entered in the "TC" or "UB" Setup Sub-Menu function.

To preset the generator it must first be in the GEN MAN R/S mode and can be running or stopped. Following this, actuate and hold SET for 1 second. After 1 second the generator time code value will change to the last value used to preset the time code. This last value can be either all zeros: "00:00:00:00, or the TC preset value entered via the TC Setup sub-menu, whichever one was used last time to preset the generators starting time.

If SET is maintained actuated, then the time code and/or user bits will sequentially preset either to zero or to their previously entered preset value every second to provide all four possible combinations of presetting or zeroing the time code and user bits. Once the desired preset combination for time code and user bits has been selected, then this is what the generators time code and user bits will be set to the next time the generator is preset.

4.14 "GEN AUTOJAM" Mode

Setting the GEN time to automatically match that of another time source is called "jamming" the generator. Jamming is an instantaneous forced type of event. One instant the generated time code is at a particular time value, and the next instant it's time is set to match that of another time source.

In GEN AUTOJAM mode the PTG2 jams the time code generator to an externally applied time code or GPS time/date signal. Once jammed the PTG2 starts flashing the LED at a 1PPS rate and outputs new time code with a time value that matches the time code input and a user bit value that is set according to the options selected in the user bit setup menu.

When jamming to a time code input the PTG2 always jams on frame 00 of the input time code to maintain best jam accuracy. After being jammed, PTG2 operation cannot be changed until the PTG2 is first powered off and then back on again. This is so it cannot be accidentally started or stopped once its been jammed to a reference time.

If jamming to GPS time and it is desired to jam several PTG2's, it is more accurate to first jam one unit and then use the time code output from that unit as the jam source for the other PTG2s. This way they will all be set to exactly the same time relative to each other. If they are all individually jammed to the GPS data then their times may not match as close because GPS data is not output at a consistent amount of time following the start of each new 1PPS GPS second.

4.15 Genlocking the Generator to a Reference

Maintaining generated time code phase synchronized to an external reference is called "genlocking" the generator. The term "genlock" means GENERator LOCKed and it is a continuous process of fine tuning, making small, gradual adjustments of the generators timing to have it's FPS rate exactly match that of the FPS rate of the reference input. If the reference input FPS rate changes slightly, the generator follows it so that they are always maintained "in step" and locked together.

The PTG2 time code generator can be genlocked to standard analog NTSC or PAL composite video, called a "bi-level" reference signal, or to a "tri-level sync" reference signal as used in HD systems.

The time code frame rates that genlock to a composite video signal are 23.976, 24, 25, 29.97DF, 29.97NDF, and 30 FPS. The frame rates of 50/720P, 50/1080I, 59.94/720P, 59.94/1080I require tri-level sync input for genlocking the time code.

4.16 Genlock Indicators

PTG2 genlock is indicated by display of a small flashing "L" following "GEN:" on Line-1 of the OLED display, as shown below:

OLED Display	Description
GEN: L HH:MM:SS;FF	Generator mode, "L" = Genlock, HH:MM:SS;FF = TC time value (";" = DF TC)
29DF UU:UU:UU:UU	Frame rate = 29.97 FPS drop frame, UU:UU:UU:UU = TC user bit values

Note that the small "L" flashes ON and OFF when the time code generator is genlocked to the reference input.

In addition, if the PTG2 is operating in the GEN AUTOJAM mode and has been jammed, there is a double 1PPS flash of the red LED at each new second, rather than a single 1PPS flash, to also indicate the generator is genlocked.

4.17 Reader Modes

In "RDR TCR/GPS" mode the PTG2 reads SMPTE longitudinal time code or GPS messages (from a GPS receiver) input to the PTG2 TC I/O GPS IN connector. When an input signal is applied the PTG2 it looks for data types and sequences that match those of SMPTE time code or GPS NMEA time/date messages. This process usually takes a few seconds for the PTG2 to sift through and identify, validate, and select the correct data type.

The following figure show a typical RDR mode display as it is when "RDR TCR/GPS" is first selected. There will be zeros for all time code and user bit values unless the RDR mode was used previously, in which case the values last read are displayed.

OLED Display	Description
RDR HH:MM:SS;FF UU:UU:UU:UU	Reader mode, HH:MM:SS;FF = last RDR TC time value (";" = DF time code) UU:UU:UU:UU = last RDR TC user bit values

When good data is found it is output to the OLED display and the "RDR" text changes to "TCR:" if reading SMPTE time code or to "GPS:" if reading GPS serial data. This automatically selected TCR or GPS mode stays in effect until the other code is read, for example the TCR mode stays selected until GPS data is read, or until the PTG2 operating mode is changed.

4.18 "TCR" Reader Mode - Reading Time Code

When reading time code the PTG2 reads at play speed in forward direction and the LED flashes at the frame rate. The time code value is displayed on Line-1 and the user bits are displayed on Line-2 as shown below

OLED Display	Description
TCR HH:MM:SS;FF	TCR mode, HH:MM:SS;FF = TC time value (; = drop frame time code)
29DF UU:UU:UU:UU	29.97 FPS drop frame, UU:UU:UU:UU = TC user bit value.

The FPS frame rate of the time code input is also displayed on Line-2. As when generating time code, the numbers 23.9, 24F, 25F, 29DF, 29ND, and 30F are displayed for the frame rate of the incoming time code.

Note that when reading either 23.976 FPS or 24 FPS time code, the display initially alternates between displaying "23.9" and "24F" for the FPS, and when reading 29ND, 29DF, or 30 FPS time code, the display alternates between "29ND" or "29DF" and "30F" for the FPS rate.

This alternating condition continues for several seconds until the reader has completed measuring the actual FPS rate of the incoming time code. After the FPS rate has been determined then the measured FPS rate is displayed. The FPS measurement process operates continuously when time code is being read. If the time code is stopped, disturbed, or changed, then it's frame rate may again start alternating between two values until a valid measurement is completed.

4.19 "GPS" Reader Mode - Reading GPS Data

When reading GPS data the PTG2 reads and automatically selects between three different standard GPS NMEA "sentences" for time or time and date. These sentences are \$GPGGA, \$GPRMC, and \$GPZDA. The time information is UTC (Greenwich Mean Time), not local time. The "GGA" message does not have date information, the RMC and ZDA messages do have the date.

If you are jamming the PTG2 using a GPS input, setup your GPS receiver to output either ZDA or RMC data if available and if you want the date in the user bits. If you can only get GGA data, then you can manually preset the user bits to the date and then set the jam mode to cause the PTG2 to jam the user bits using these manually entered values.

When reading GPS data, Line-1 displays the GPS hours, minutes, and seconds time value as "HH:MM:SS:FF", where HH is the hours, MM the minutes, and SS the seconds. The frames value is set to "00" since there is no frame information in the GPS data.

Line-2 displays the GPS date value as 00:YY:MM:DD. This year-month-day format for the date is in an international format. If there is no date information in the GPS serial input, then Line-2 is set to all zeros.

OLED Display	Description
GPS HH:MM:SS:00	GPS mode, HH:MM:SS:00 = GPS UTC time value (frames value always = 00)
DATE 00:YY:MM:DD	UU:YY:MM:DD = GPS UTC year, month, day date value .

Usually GPS data is received as bursts of data once each second. When reading and displaying GPS data, the PTG2 LED turns OFF as GPS data is received, then stays steady ON. This repeats once each second.

Note that depending on how the user bit jam mode has been setup the GPS date may be output in the user bits of the time code or not. See the section in this manual describing options for jamming the user bits.

4.20 Holding/Freezing the Reader Display

When in the RDR mode and reading time code or GPS data, the display can be held or frozen simply by actuating the SET switch. Alternate actuation acts like a hold/run function for the reader time display.

4.20 PTG2 System Reset

The PTG2 has a System Reset function that will initialize the PTG2 to a known state should it appear that a malfunction has occurred in PTG2 operation. To use the System Reset function perform the following steps:

1. The PTG2 must either be OFF or in the "Operate" mode (not in SETUP).
2. Actuate and hold the SEL switch for 5 seconds. If not powered up, the PTG2 will first power up and then

switch to SETUP mode after 1 second, then after 4 more seconds the PTG2 will perform a System Reset.

3. After system reset PTG2 operation is set for the following:

- a. Generator mode is set to "MAN R/S"
- b. Output level is set to LINE level.
- c. The FPS rate is set to 29.97 DF
- d. The Preset TC and Manual UB EEPROM memories are cleared to all zeros
- e. The jam User Bits are set for "ALL RDR"

5 GLOSSARY

5.1 Word and Acronym Definitions

It is helpful to understand the meaning of various words and acronyms used in this manual so they are defined or explained as follows:

DF	“Drop Frame” time code - See “SMPTE Time Code” in paragraph 5.2
EBU	European Broadcast Union - A European standards setting organization.
FPS	Frames-Per-Second - “Frame rate” of video, film, or time code. The number of times in a second that a frame of video, film, or a time code is changed or updated.
Free-run	Free running - Not locked to a reference. “free range” time code. See Genlock
Genlock	To lock signals together such that one is a timing reference for the other. For example, to lock time code generation to a video reference so that each frame of time code is generated in exact synchronism with the generation of each frame of video.
HD	High Definition video. HD video is delivered at frame and line rates that provide much finer definition in the picture. There are many HD frame rates currently in use, as well as new ones being developed.
Jam	To electronically preset a time code generator to the same time as another time source to cause the generated time code to have the same time value as that of the source time.
LTC	Longitudinal/Linear Time Code - See “SMPTE Time Code” in paragraph 5.2
NDF	“Non-Drop Frame” time code - See “SMPTE Time Code” in paragraph 5.2.
NTSC	National Television Systems Committee - US standards setting organization. Also referred to as the 525 line, 29.97 FPS video standard for the first US color television system.
PAL	Phase Alternating Line - The 625 line, 25 FPS video standard for one of the first European color television systems.
PPS	Pulse-Per-Second - A positive or negative going "pulse" type signal that occurs once-per-second.. Also sometimes written as 1PPS. The 1PPS signal derived from the GPS system of satellites "ticks" at the same instant of time everywhere on earth.
Preset	To set a time code generator to the same time as another time source to cause the generated time code to have the same time value as that of the source time. Differs slightly from the "Jam" operation in that preset generally refers to setting the TCG time to a manually entered user "preset" value.
SD	Standard Definition - generally refers to the original analog color television specifications of the US "NTSC" system of 525 interlaced lines at 29.97 FPS, or the European (EBU) "PAL" equivalent of 625 interlaced lines at 25 FPS.
SMPTE	Society of Motion Picture and Television Engineers - A US standards setting organization. Usually Pronounced “sim-tea” or “simpt-tea”

- TC Time Code - See paragraph 5.2 “ SMPTE Time Code”.
- TCR Time Code Reader – reads (decodes) SMPTE time code. The PTG2 incorporates an internal multi-frame-rate SMPTE time code reader., sometimes referred to in this manual as the “PTG2 TCR” or just the “TCR”.
- TCG Time Code Generator - generates SMPTE time code. The PTG2 incorporates a multi-frame-rate internal SMPTE time code generator, sometimes referred to in this manual as the “PTG2 TCG” or just the “TCG”.
- UB User Bits - See paragraph 5.2 below, “SMPTE Time Code”.

5.2 SMPTE Time Code

SMPTE time code is an electronic timing signal that assigns a unique number to identify each individual frame (image) of video or film. SMPTE time code was initially developed in the 1960’s to facilitate the operation of electronic video tape editing systems, but has since found numerous other applications.

As an electronic signal, SMPTE time code has a frequency range that allows it to be recorded on an audio recorder or the audio track of a video recorder.

Sometimes SMPTE time code is referred to as “longitudinal” or “linear” time code because of it originally being recorded on a continuous path along the length of a video or audio tape, rather than being recorded on slanted "tracks" via a spinning head as is the method for video recording.

SMPTE Time Code Format - Instead of numbering video or film frames starting with frame number 1 and then counting on up into the thousands of frames from there, SMPTE time code numbers each frame in an hours, minutes, seconds, and frame number format: “HH:MM:SS:FF”. This produces a “digital clock” type of time representation for each frame number.

So, with SMPTE time code you end up with a unique frame number as well as a time value that goes up to 24 hours. For 30 FPS time code the time code would start at 00:00:00:00 and count on up to 23:59:59:29 after exactly 24 hours of elapsed time.

SMPTE Time Code Bits - The SMPTE time code format provides eighty (80) digital bits of information per frame.

"Sync Pattern" Bits - Sixteen (16) bits are used to assist in locating and properly decoding the other 64 bits of the time code. These bits are generally called the "sync pattern" or "framing" bits.

Time Bits - Thirty two (32) of the remaining 64 bits are sub-divided into 8 groups of 4 bits each to encode the hours, minutes, seconds, and frame number of the actual SMPTE time code time value for a particular video/film frame.

User Bits - The last remaining thirty-two (32) bits are “extra” and are available to encode "user" information as desired. This could be additional information such as the date, a production number, an experiment number, etc. Like the time code, the 32 User Bits are usually sub-divided into 8 groups of 4 bits each and can have the numeric values of 0-9 and in addition, the hexadecimal values of A-F.

Time Code Frame Rates - SMPTE time code can be generated at different frame rates in order to accommodate the variety of video and film frame rates in use today. This match of time code and image frame rates is necessary in order to be able to assign a specific time code number to each individual image frame. Matched frame rates insure that a time code frame number does not “straddle” more than one frame, or more than one frame does not straddle more than one time code number.

Some of the more common frame rates for SMPTE time code are as follows:

30 FPS - Compatible with US black and white (B/W) SD analog television frame rate. This time code frame rate is also compatible with 60 FPS HD frame rate applications.

29.97 FPS - Disregarding time code for a moment, this "slightly less than 30 FPS" frame rate of 29.97 FPS resulted from the need to slow down the B/W TV frame rate of 30 FPS by 0.1% in order to make color TV more "compatible" with and

watchable on the B/W TV sets already in use. The 0.1% slowdown results in a frame rate of 29.97 FPS, which is simply $30 \text{ FPS} \times 0.1\% = 0.030 \text{ FPS}$, and $30 \text{ FPS} (-) 0.030 \text{ FPS} = 29.97 \text{ FPS}$.

29.97 FPS NDF - NDF = Non-drop frame time code. Although 29.97 FPS time code is compatible with the NTSC analog SD color television frame rate, its actual time value lags that of "real time" by that 0.1% value. This time code frame rate is also compatible with 59.94 FPS HD frame rate applications.

29.97 FPS DF - DF = Drop Frame time code. Drop frame time code is compatible with the US NTSC SD analog color television frame rate of 29.97 FPS and also maintains a nominal "real time" time value by skipping frame numbers 00 and 01 at the start of every minute except on the tens of minutes. It's just the numbers 00 and 01 of the time code that are skipped, no actual frames are skipped or dropped. This time code frame rate is also compatible with 59.94 FPS HD frame rate applications.

See "Drop Frame Time Code" in the following paragraphs for more information.

25 FPS - Compatible with European PAL SD analog television frame rate. Also called "EBU" time code. This time code frame rate is also compatible with 50 FPS HD frame rate applications.

24 FPS -Compatible with standard film frame rate of 24 FPS. This time code frame rate is also compatible with 48 FPS HD frame rate applications.

23.976 FPS - This is the standard 24 FPS film frame rate slowed down by the same 0.1% percentage that the B/W TV video frame rate was slowed to when NTSC color television was adopted in the 1950's. For 24 FPS this amount is 0.024 FPS and $24 \text{ FPS} (-) 0.024 \text{ FPS} = 23.976 \text{ FPS}$. Used in various video and film recording, editing, and transfer applications.

Time Code Frame Rates for HD - Although there are many different frame rates in use for HD video, the majority are all multiples of the earlier frame rates used for SD television, in order to be backwards compatible. This backwards compatibility has also allowed the earlier SD SMPTE time code frame rates to also be used for HD video. For example, 29.97 FPS time code can be used with 59.94 FPS video when allowances are made for understanding that each frame number of the time code applies to two frames of the associated HD video, in much the same way that each frame of time code for SD video applies to two fields of video.

Time Code Time and Real Time - "Real time" is the passage of time as measured by a clock. Although SMPTE time code has a clock type time format, its time value may or may not match that of real time. This means that even though it may look like the "seconds" of the time code are changing once a second, they may be changing at a slower or faster rate.

The "real time" time value of SMPTE time code running at 24 FPS, 25 FPS, and 30 FPS matches that of real time. The time value of time code running at 29.97 FPS DF SMPTE time code pretty much matches that of real time.

The "real time" time value of 23.976 FPS and 29.97 FPS NDF SMPTE time code runs slower and does not match that of real time, proceeding to get further and further off as time passes.

Time Code and Time of Day - Although it ultimately depends on the accuracy of the time code generator, when running at one of the integer frame rates or 24, 25, or 30 FPS, SMPTE time code can be set equal to and will maintain accurate time-of-day time.

Drop Frame Time Code - The exception to time code time matching real time is the time code used with the NTSC video system. In this system the frame rate as represented by the frame numbers is 30 FPS. However, the frame numbers are counted up by a time base that is running just slightly slower than 30 FPS, running at only 29.97 FPS. So, after counting for one second of real time, the frame number isn't at frame 30 yet, almost, but not quite. It takes just another 0.03 seconds more of real time for the next 29.97 FPS tick to roll the frame count over to the 30th frame. So this SMPTE clock is running slower than real time, even though it has an hours/minutes/seconds display format.

As time goes by, the amount of real time error continuously increases until the SMPTE time code time value eventually lags that of real time by about 3 1/2 seconds an hour. To compensate for this error, the normal frame number counting sequence is altered slightly during generation of the time code.

In 30 FPS time code the frame number count starts at frame "00", advances on up to frame number "29", then wraps around to frame 00 and starts over; 00,01,02.....28,29,00,01,02. Each time the frame count wraps around to frame 00 the seconds change to the next second, then eventually the minutes and hours change in typical clock fashion. However, after

counting for one minute the time code time value has fallen behind real time by about two frames worth of time, about 66 thousands of a second (66ms), which is the time for two frames of video.

The method chosen to correct this two frames a minute lag in real time was simply to start the frame count at 02 instead of 00 at the start of each new minute. Then continue counting as normal. This is called "drop-frame" time code, although no frames of anything are actually "dropped".

So, with drop frame time code, at the start of each minute the frame count wraps from 29-to-02 instead of 29-to-00, skipping the numbers 00 and 01;27,28,29,02,03..... The result is that the SMPTE time code time gradually falls behind real time for a minutes worth of time, then jumps ahead when the next new minute starts, then gradually falls behind again. Although there is a continuously varying short time error, the overall real time error is greatly reduced.

Actually, to fine tune the real time accuracy of drop frame time code, the once a minute drop-frame correction is not performed whenever the minutes change occurs at the start of a new tens of minutes. At the start of each tens-of-minutes the frame number count wraps normally, from 29-to-00, rather than from 29-to-02.

Drop frame correction of the time code is a continuous process and it is not noticeable that it is occurring when looking at a real time clock display using 29.97DF SMPTE time code.

Non-Drop Frame Time Code - Non-drop frame time code is time code using the 30 FPS time code numbering system that is actually counted or advanced at the slightly slower frequency of 29.97 times-per-second, and in which drop frame correction is not performed. This causes the time code real time value to lag behind and not match that of actual real time. However, in this format there are no skipped frame numbers.

6 SERVICE AND TROUBLESHOOTING

6.1 Service

Do not attempt to disassemble your unit to service it. There are no user-serviceable parts inside. You can return your unit to HORITA for service or repair. Please contact HORITA first before returning your unit.

6.2 Troubleshooting

The following provides a list of the most common items to check if you are having trouble with your unit.

- a. Check for a dead battery
- b. Check all cables in signal paths for opens or shorts.
- c. If using XLR-to-RCA adapters, apply the time code from the RCA connector to an audio monitor and listen for the "raspy" time code sound. If no time code is present, it may be necessary to disassemble the XLR adapter and switch the wiring between pins 2 and 3.

7 SPECIFICATIONS

Battery 9Volt, NEDA/ANSI 1604A

Switches and Indicators

POWER Momentary ON-OFF-ON toggle switch
ON (SEL)
R/S (SET)

LED Red, indicates power ON and flashes when reading or generating time code
OLED Displays 2 lines of 16 characters each, high efficiency yellow color

Time Code

Format SMPTE time code format running at frame rates of 23.976, 24, 25, 29.97DF, 29.97NDF, or 30FPS
Input Level 0.5 to 10 volts p-p (-20dBV 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
Connector BNC
Generator Drift Less than +/-1 frame per hour over temperature range

GPS

Input Level RS-232
Format NMEA \$GPGGA, \$GPRMC, or \$GPZDA
Baud/bits 4800, 8 bits, no parity

Ref Input

Input Level RS170A composite NTSC video or equivalent 625/50 PAL video, 1 volt P-P
Tri-level HD sync for 50/720P, 50/1090i, 59.94/720P, 59.94/1080i
Impedance Terminated at 75 Ohms

Environment

Operating 5-to-40 degrees C (41 to 104 degrees F)
Storage -10-to-60 degrees C (14 to 140 degrees F)

Dimensions

1" H, 2.4" W, 4.75" D

Weight

5 Oz, including battery.

Specifications subject to change without notice