HORITA TRG-100

Multi-Frame-Rate SMPTE Time Code Reader/Generator With LED Display

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

50/720P, 50/1080i, 59.94/720P, 59,94/1080i HD Tri-Level Sync Compatible

USER MANUAL

Software Version TRG2.01

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HORITA®

P.O. Box 3993, Mission Viejo, CA 92690 (949) 489-0240

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1 GENERAL

This manual provides instructions for installing and operating the HORITA TRG-100. The TGR-100 is a multi-frame-rate SMPTE time code reader/generator with a 0.56" high eight character LED display. The Time Code Reader (TCR) and Time Code Generator (TCG) functions both read and generate “longitudinal” format SMPTE time code (LTC) at multiple frame rates to provide an ideal TCR/TCG for use in studio, field, editing, engineering, and post production situations.

The TCR function can read time code at "speed" rates from about 1/10th "play speed" up to about 10 times play speed. "Play speed" refers to the basic frame rate of the time code when first generated or recorded onto an audio recorder. When a recording of time code is "played back", the playback speed may be usually be sped up or slowed down and the resultant FPS "speed" of the time code also increases or decreases in direct proportion.

When reading play speed time code the TCR measures and displays the basic FPS frame rate of the time code being read and can discern between 23.976 and 24FPS as well as between 29.97 and 30FPS time code.

The TCG function consists of a highly accurate very low drift crystal controlled time base that sets the basic frame rate of the generated time code. The initial TCG start time value can be manually preset by the user or electronically preset (jammed) from an external SMPTE time code input. After initial presetting and startup the TCG can be set to thereafter free-run or to genlock (phase lock) to an externally applied time code or to a bi-level/tri-level (HD) video reference input signal.

The TRG-100 is easy to operate and simple to set up. Four front panel switches allow the user to quickly select TCR or TCG time or FPS display, change TCG FPS rate, start/stop/preset the generator, select the genlock source, etc. Both balanced and un-balanced time code inputs and outputs provide for quick hookup into different time code situations and applications.

2 FEATURES

- The TRG-100 time code reader and time code generator functions are multi-frame-rate and can read and generate SMPTE time code at frame rates of 23.976, 24, 25, 29.97DF (Drop Frame), 29.97NDF (Non-Drop Frame), and 30FPS (also non-drop frame).

- The LED display consists of eight 0.56" high red characters and shows the TCR and TCG time code hours, minutes, seconds, and frame number in familiar HH:MM:SS:FF format, the time code "user-bit" values, the FPS frame rate, and any TCG preset value.

- LED indicators show if the TCR or TCG is selected for display, drop frame time code, Preset-1, Preset-2 selected to preset the TCG, TCG genlock status, and TCR FPS detect status.

- Provides both balanced XLR and unbalanced RCA inputs and outputs for time code.

- TCR reads SMPTE time code at speeds from about 1/10th play speed up to about 10 times play speed.

- TCR "auto FPS detect" mode operates continuously in the background to detect the 23.976, 24, 25, 29.97DF, 29.97ND, and 30FPS frame rates. "FPS DET" LED indicator shows when the frame rate has been accurately detected and measured.

- TCG starting time can quickly be preset either to one of two user preset values or "jammed" to the time code value being read by the TCR. Likewise, the "user bit" portion of the TCG time code can be set to match that of the TCR or can be manually preset.

- TCG "Run/Stop" momentary action switch permits quick starting and stopping of the TCG incrementing the time code value.

- TCG operation can be set to free-run or to "genlock" the generated time code to the incoming video or to the incoming time code. LED indicator shows if TCG is genlocked or not. When in free-run mode the TCG has a very low drift rate of a maximum of +/- 1 frame-per-hour.

- NTSC/PAL composite SD video ("bi-level") or HD tri-level sync input can be used for TCG video genlock reference.
- TCG 29.97DF or 29.97ND time code can be genlocked to externally applied 29.97DF or 29.97ND time code, or to 29.97 NTSC SD video or to a 59.94/720P or 59.94/1080i HD tri-level sync signal.
- TCG 24, 25, or 30FPS time code can be genlocked to an externally applied 24, 25, or 30FPS time code or SD composite video signal, or to a 50/720P or 50/1080i HD tri-level sync signal.
- TCG 23.976 time code can be genlocked to a 23.976 or 29.97 SD video input or to a 23.976 or 29.97ND time code input.
- Operates from a small AC power adapter, which is included, or can be operated in the field from 9-to-12 volts DC battery power.

3 CONNECTING

Figure 3-1 below shows the basic hookup for the TRG-100 in a typical application.

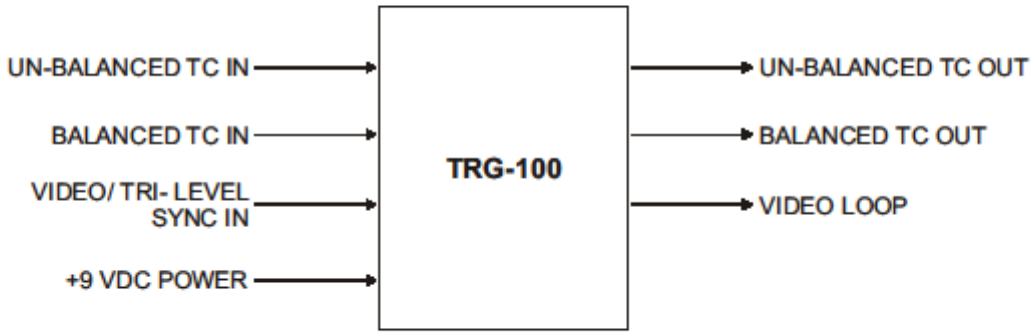

Figure 3-1, Basic TRG-100 Hookup

3.1 Connecting Power

Included with your TRG-100 is an AC power adapter that provides a 9 volt, 500 milliamperes DC output. This adapter is equipped with a 3.5mm mini-phone plug. The center pin receptacle is "+" (positive) voltage polarity. Insert the power plug into the TRG-100 "+9V POWER" connector and plug the adapter into the 110-120 volt, 60 Hz AC power. Note that you may also have been supplied with an equivalent power adapter for use with other mains supply voltages and for operation at 50-Hz AC power.

WARNING:

ELECTRICALLY OPERATED PRODUCT

As with all electrical products, precautions should be observed during handling and use to prevent electrical shock.

NOTE:

Make sure the plug is inserted all the way into the power connector. The TRG-100 has internal protection circuitry to prevent it from being damaged should the wrong polarity of power be applied. However, do not use an adapter of more than 9 volts at 500 milliamperes or damage to the TRG-100 may result.

3.2 Operating From Battery Power

You can operate your TRG-100 from battery power in order to use it in the field. The TRG-100 operates from 9-to-12 volts DC and you will need to connect it from the battery to a 3.5mm mini-phone plug, with the tip being positive (+).

3.3 Connecting Video IN and OUT

For video genlock of the TCG, the TRG-100 accepts either an NTSC or PAL standard definition (SD) analog composite video signal or in HD applications it accepts an HD tri-level sync signal. The TRG-100 Video IN and OUT are "looping" connections so the TRG-100 does not terminate the video. In order for the TCG video genlock operate correctly, the video must be terminated at 75 Ohms. Connect the desired video source to VIDEO IN and either install a 75-Ohm terminator onto

the VIDEO OUT connector, or connect VIDEO OUT to a downstream piece of video equipment that terminates the signal. The TRG-100 is shipped with a 75-Ohm terminator installed.

3.4 Connecting Time Code IN and OUT

The TRG-100 accepts and provides both balanced and unbalanced time code input and output signals. Connect time code from the time code source to the TC IN on the rear panel, using the RCA connector if unbalanced or the XLR-3 connector if balanced. As with the time code inputs, RCA and XLR-3 connectors are used for the unbalanced and balanced time code outputs.

4 OPERATING

The following paragraphs describe the general scheme for setting up and operating the TRG-100. Because of the variety in both the needs of the user and the capabilities of the TRG-100, this manual provides only descriptions of the functions of the various TRG-100 settings, along with a more general description of TRG-100 operation. Specific setup of all of the TRG-100 parameters for a particular need or application is left to be determined by the user, after acquiring an understanding of the capabilities and each of the specific functions of the TRG-100.

4.1 "POWER ON" Switch

To operate the TRG-100 after connecting it into your system as described in SECTION 3 of this manual, set the TRG-100 POWER switch located on the rear panel to ON.

4.2 "BRIGHTNESS" Control

The brightness of the LED display is adjustable via the BRIGHTNESS control located on the rear of the TRG-100.

4.3 "MODE" Switch

The MODE switch is a three position switch labeled TCR-TCG-SET. The TCR and TCG positions select between the basic time code reader or time code generator functions. The SET position is momentary action and is used to start and stop the TCG and also to setup TCG preset values as described in later paragraphs.

4.4 "GENLOCK" Switch

The GENLOCK switch is a three position switch labeled VID-OFF-TCR. This switch selects between using either the video or time code input as the TCG genlock source, or to turn genlock off and let the TCG free-run.

4.5 "COUNT" Switch

The COUNT switch is a momentary action three position switch labeled (-) (+) with a center "off" position. This switch is used to count up or count down a previously selected value.

4.6 "DISPLAY" Switch

The DISPLAY switch is a three position switch labeled UB-TC-FPS and selects one of these values to be displayed on the LED display: TC for Time Code, UB for User Bits, and FPS for Frames-Per-Second frame rate.

4.7 LED Display and Colon LEDs

The LED display is an eight character 7-segment red LED display that shows the time code time, user bits, or FPS rate for the TCR or TCG functions. The eight 7-segment display characters are separated by "colon" characters made up from three pairs of individual red LEDs. The colons separate the display characters into four pairs of digits to make a HH:MM:SS:FF time display. See Figure 4-1.

Although used together as colon separators between the digits, the colon LEDs are also used individually as TCR and TCG operating status indicators. In addition, there is a seventh LED to indicate if the time code is drop frame or non-drop frame.

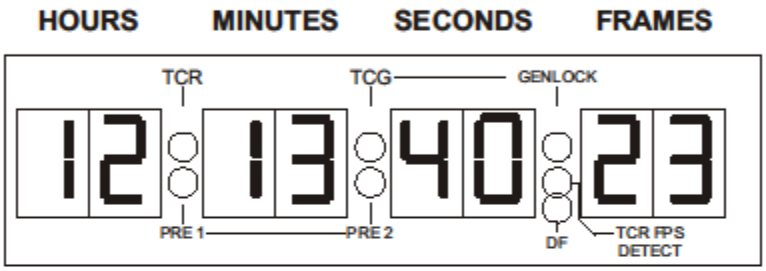

Figure 4-1, TRG-100 LED Display and Display Colons

4.8 Time Code Time Display Format

The TCR/TCG time code value is displayed in a numerical clock format of four pairs of digits, 2 each for hours, minutes, seconds, and frames, with the pairs of digits separated by colon characters as shown in figure 4-1.

The hours value can range from 00-23, minutes and seconds value from 00-59, and frames from 00-to-the maximum value for whatever the FPS rate is. Note that 23.976 FPS is really 24 FPS that's running slow, and 29.97 FPS is 30 FPS that's running slow, so there isn't an actual frame number 23.976 or 29.97. Frame numbering starts with frame "00" (instead of 01) so for 23/24 FPS for example, the highest frame number is 23, for 25 FPS it's 24, and for 29.97/30 FPS it's 29.

4.9 Time Code User Bit Display Format

The user bits of the time code are displayed in a digital format as four pairs of numerical digits separated by the colon LEDs. Each of the user bit characters can have a hexadecimal value from 0-9 and A-F: 0-1-2-3-4-5-6-7-8-9-A-B-C-D-E-F. Because of the limited characters available using a 7-segment display, hexadecimal characters A-F are displayed as: A-b-C-d-E-F.

4.10 FPS Display Format

The FPS display shows the FPS rate of either the TCR or the TCG. The following table shows the TCR and TCG FPS display and the actual associated FPS:

TCR/TCG FPS DISPLAY	ACTUAL TC FPS
23.976	23.976
24	24
25	25
29.97 dF	29.97 Drop frame
29.97 ndF	29.97 Non-drop frame
30	30
TCG FPS DISPLAY (HD)	
50 720P	25
50 1080i	25
59.94 720P	29.97 Drop frame
59.1080i (59.94 1080i)	29.97 Drop frame
=rdr	Set to match the TCR FPS rate whenever the TCG is "jammed"

Table 4-1, TCR and TCG FPS Displays

4.11 "TCR" Colon LED

When ON, the TCR LED indicates that the TCR has been selected for display of the time code, user bits, or FPS rate of the time code input. In addition to this use, the TCR LED also indicates whether or not the TRG-100 is reading an active input time code. When reading time code the TCR LED flashes at the frame rate of the time code. When not reading time code the TCR LED is steady ON.

4.12 "TCG" Colon LED

The TCG LED indicates the TCG has been selected for display of the time code, user bits, or the FPS rate of the TCG time code output. In addition to this use, the TCG LED also indicates if the TCG is "stopped" or is "running". When the TCG is

running the TCG LED flashes at the frame rate of the generated time code. When the TCG is stopped the TCG LED flashes ON and OFF about two times a second, along with other LEDs that would normally be ON.

4.13 "GENLOCK" Colon LED

The GENLOCK LED indicates whether or not the TCG time code output is phase locked to the selected genlock source. If the GENLOCK LED is OFF, the time code is not genlocked. If the LED is flashing at the frame rate the time code is genlocked at the frame rate. If the LED is flashing at 1-PPS then the time code is genlocked at the 1-PPS rate.

4.14 "PRE1" and "PRE2" Colon LEDs

The PRE1 and PRE2 LEDs indicate which Preset memory is active for presetting the TCG time value and which is active for both presetting and for jamming the TCG user bits.

When either the PRE1 or PRE2 LED is ON this indicates that the associated Preset value is active. When both LEDs are ON this indicates that the Preset value is the last value that was generated by the TCG just before it was stopped.

4.15 "TCR FPS DETECT " Colon LED

The TCR FPS DETECT LED indicates whether or not the frame rate of a time code input to the TRG-100 has been detected and measured by the TCR. If the LED is OFF then the FPS has not been measured. If the LED is flashing then the FPS is actively being measured. If the LED is steady ON then the FPS of the TCR input time code has been measured and can be displayed. The FPS measurement process operates in the background in both TCR and TCG modes of TRG-100 operation.

4.16 "DF" LED

The DF LED indicates if a 29.97 FPS time code being read or generated is drop frame or non-drop frame. When the LED is ON this means the time code is drop frame format.

4.17 Selecting Time Code, User Bits, or FPS for Display

The DISPLAY switch is used to select what is displayed on the LED display. UB selects the time code user bits value, TC selects the time code time value, and FPS selects the FPS rate of the time code.

The FPS display value is for the TCR if in TCR mode, and for the TCG if in TCG mode.

4.18 Selecting TCR Operation

TCR operation is selected when the MODE switch is in the TCR position. In this mode the TCR can read and display time code at rates of from about 1/10 play speed up to about 10X play speed.

If the TCR be selected as the genlock source when in the TCG mode, the TCR operates to read time code, however it reads only at play speed.

4.19 Selecting TCG Operation

TCG operation is selected when the MODE switch is in the TCG position. In this mode the TCG generates time code at one of six FPS rates and the time code can free-run or be genlocked to time code or video inputs.

4.20 Starting and Stopping the TCG Time Code

The TCG is started and stopped by actuating and releasing the MODE switch to the SET position. "Starting" the TCG means allowing it to increment it's time code time value at the selected FPS rate. "Stopping" means holding the time code time value at a fixed HH:MM:SS:FR time. This "frozen" time code time and user bit information is continuously sent out at the selected TCG FPS rate. Also, any colon LEDs that were ON when the TCG was running will flash slowly when the TCG is stopped.

4.21 TCG Time Code Jam and Genlock Operation

Setting the CG time to match that of another time code source is called “jamming” the TCG. It is an instantaneous forced type of event. One instant it’s at a particular time value, the next instant it’s time is set to match another time.

Once jammed, further maintaining the TCG time code phase synchronized to an external reference is called “genlocking” the TCG. Genlock means GENerator LOCKed and is a continuous process of fine tuning, making small, gradual adjustments of the TCG's FPS rate to have it continuously match that of the FPS rate of the selected reference input. If the

reference input FPS rate changes slightly, the TCG follows it so that they are maintained "in step" and locked together. The TCG can be genlocked to either the time code being read by the TCR or to an external video reference input signal.

4.22 "Jamming" The TCG Time

The TCG time code value is jammed (automatically set) to the TCR time value when the TRG-100 MODE switch is switched from TCR to TCG and the TCR has been reading valid play speed time code. After being switched to the TCG mode, the actual jam operation takes place when the next frame number "00" of the time code is about to be read.

An exception to this automatic jam operation is made when the FPS is selected for display. When this is the case and the MODE switch is switched from TCR to TCG, the TCG FPS is displayed without causing the TCG to jam or re-jam.

The jam process is such that when first switched from TCR to TCG, the TCR continues reading time code and flashing the TCR LED at the TCR frame rate until frame 00 is the next frame of time code about to be read. When this occurs the TRG-100 time code output is switched over from re-shaped TCR time code to TCG time code and the TCG is started. The TCR LED is extinguished and the TCG LED starts flashing at the selected TCG frame rate.

If the TCR time code being read when is not valid or is not at play speed when the MODE switch is changed from TCR to TCG, the jam operation is not performed and although the TCG is selected, it is stopped.

4.23 "Jamming" The TCG User Bits

The eight (8) TCG user bit characters are also jammed to a user selected source value at the same time that the time code time value is jammed. The TRG-100 permits the user to select the UB jam source as the PRE1, PRE2 preset memory values, or as the most current TCR UB values.

4.24 Selecting the Jam Source for the TCG User Bits

The jam source for the TCG user bits is determined by whatever user bit Preset memory is selected at the time the user bits are jammed. For example, if both the PRE1 and PRE2 LEDS are ON, then the TCR user bits are the jam source for the TCG user bits. The PRE1, PRE2, or TCR selection can be determined simply by displaying the TCG user bits and noting the status of the PRE1and PRE2 LEDs.

4.25 "Genlocking" The TCG

After the TRG-100 has been jammed to the source time, in most cases it can be kept "genlocked" to the jam source time code or to a video/sync input to the TRG-100. Genlocked means phase locked and this in turn means that, for example, if the frame rates of the TRG-100 time code IN and time code OUT are the same, and if the TRG-100 was genlocked to the TCR by setting the GENLOCK switch to TCR, then both time codes would match exactly, with both being in step bit-for-bit as they were being read and generated. When the TCR was reading the input bits for the units of frames, the TRG-100 would be outputting the exact bits for the units of frames.

When the time code is genlocked to video this means the TRG-100 starts generating the frames value of the time code exactly at the start of the video frame, and ends with the time code hours value and sync pattern exactly at the end of the video frame. This process is continuously repeated as each frame of time code and video is generated, and helps insure that when a time code number is later read that it is for that particular video frame that it overlaid in time.

If the time code input to the TCR is the jam source but it is not locked to video, the TRG-100 can be setup to jam to the TCR time but genlock to the input video by setting the GENLOCK switch selection to VID.

When genlocking, if the frame rate of the incoming video or time code and that of the TRG-100 generated time code do not match, the TRG-100 can still be genlocked to the selected genlock signal as long as the frame rates of both resolve at each second. This means that the 24, 25, 30, and 50 FPS frame rates for video or time code can all be genlocked to each other.

When genlocking in this manner the genlock status is checked on frame 00 of each new second. This is referred to as "PPS" (Pulse-Per-Second) genlock. When the TRG-100 is performing PPS genlock it may take several seconds for the "GENLOCK" LED to start flashing at 1-PPS, indicating that genlock has been achieved. This delay is because the genlock status is sampled only once a second and the TCG genlock timing adjustments are kept relatively small compared to a time value of one second in order not to overshoot the correct timing.

Although running slower than real time, the 23.976 FPS and 29.97ND FPS frame rates also resolve at each second and therefore can be genlocked to each other. However, the 29.97ND and 23.976 frame rates can not be genlocked to any other integer time code because they simply run slower than real time, meaning that their seconds change at a slower rate than the seconds of real time are changing.

The following Table 4-3 shows all of the video and time code genlock capabilities of the TRG-100:

TCG OUT FPS	VIDEO IN FPS	GENLOCK LED FLASH RATE	TCR TC IN FPS	GENLOCK LED FLASH RATE
23.976	23.976	Frame	23.976	Frame
	29.97	PPS	29.97NDF	PPS
24	24	Frame	24	Frame
	25,30	PPS	25,30	PPS
25	25	Frame	25	Frame
	24,30	PPS	24,30	PPS
29.97NDF	29.97	Frame	29.97NDF	Frame
	23.976	PPS	23.976	PPS
29.97DF	29.97	Frame	29.97DF	Frame
30	30	Frame	30	Frame
	24,25	PPS	24,25	PPS
50 720P				
50 1080i	50	Frame	24,25,30	PPS
	24,25,30	PPS		
59.94 720P				
59.94 1080i	59.94	Frame	29.97DF	PPS
	23.976	PPS		

NOTE: "Frame" means frame rate, PPS means Pulse-Per-Second rate.

Table 4-2, TCG Video and Time Code Genlock Table

4.26 Genlocking to the Time Code Input

If the TCR and TCG frame rates are equal, the TCR and TCG time codes are genlocked at each frame time. If the TCR and TCG frame rates are any mix of 24, 25, or 30 FPS, the TCG is genlocked so that TCG frame 00 starts at the start of each new second of the input time code.

Time code genlock works like this because although the TCR and TCG frame rates may not match, for example if the TCR equals 25 FPS and the TCG equals 30 FPS, because the jam operation occurred at the start of frame 00, then exactly one second after the jam operation they will both be incrementing the seconds value of their time codes at exactly the same instant of time. If the TCR is selected as the GenLock source, then the TCG timing can be adjusted to keep the generated time code locked to the TCR tine code input.

This same genlock method works for any mix of 23.976 FPS and 29.97NDF FPS TCR/TCG time code, the TCG is genlocked so that TCG frame 00 occurs at the start of each new TCR second. Refer to Table 4-3 for more detail.

4.27 Genlocking to the Video Input

If the video and TCG frame rates are equal, that is NTSC video and 29.97 FPS time code, or PAL video and 25 FPS time code, then genlock takes place on each frame of video and time code. If the frame rates are NTSC video and 23.976 FPS time code, or PAL video and 24 or 30 FPS time code, then genlock takes place at a video derived one second rate at the start of each TCG frame 00. Refer to Table 4-3 for more detail.

4.28 Changing the TCG FPS Rate

The FPS rate of the TCG is changed by first putting the TCG into the "Preset" entry mode and then using the SET or COUNT switch to cycle through the different FPS rates. This is performed as follows:

1. Set the DISPLAY switch to FPS.

2. Next, hold the MODE switch in the SET position for two seconds until the FPS rate starts flashing ON and OFF about every 1/2 second.

3. Actuate and release either the SET switch or the COUNT (-)/(+) switch to advance to the next frame rate.

4. When the desired FPS rate is displayed, wait two seconds for the flashing to stop and the selected rate to be saved into the EEPROM memory.

4.29 Manually Entering TCG Time or User Bit Preset Values

Time or User Bit preset values for the TCG are entered by first putting the TCG into the "Preset" entry mode and then entering the desired time or user bit values using the SET and COUNT switches. This is performed as follows:

1. Set the DISPLAY switch to the desired TC or UB data you want to preset.

2. Next, hold the MODE switch in the SET position for two seconds until one or two characters on the LED display starts flashing ON and OFF about every 1/2 second. When presetting time code, two of the characters flash at once, for example both the "tens" and "ones" characters of the minutes flash together. For user bits, only one character flashes at a time.

3. If both the PRE1 and PRE2 LEDs are not illuminated, continue to hold the SET switch actuated until they both are. If you release the switch when just PRE1 or PRE2 is illuminated the TCG time will be set to that preset value and it will thereafter be displayed whenever both preset LEDs are ON until a new time has been read by the TCR.

4. With both the PRE1 and PRE2 LEDs on, release the SET switch, and then alternately actuate and release it again to select a different digit to preset. Repeat this action until the digit you desire to preset is flashing. If no other action is taken the flashing will stop after two seconds and the SET switch will again operate to start and stop the TCG.

5. When the desired digit(s) has been selected, release the SET switch and use the COUNT (+)/(-) switch to count the value up or down. If no other action is taken the flashing will stop after two seconds and the Preset mode will stop.

4.30 Using The Time Code and User Bit Preset Memories

When the TRG-100 is powered up the time code and user bits are set to all zeros. The "Preset" memories allow prior entered time or user bit values to be quickly recalled and entered into the TCG as starting values for the time code and/or user bits.

For this purpose the TRG-100 has two "Preset" memories for the time code and two for the user bits. The memories are named PRE1and PRE2 and use "EEPROM" type "chips" which retain their contents without needing any power, thus the user entered preset values remain after the TRG-100 is powered off.

If the DISPLAY switch is set to TC then the PRE1 and PRE2 memories for the time code are used. If set to UB then the user bit PRE1 and PRE2 memories are used.

The SET switch is used to select between the PRE1 and PRE2 memories and also to select a specific character to preset, while the COUNT switch is used to change the selected characters value.

4.31 Selecting Between the PRE1 or PRE2 Preset Memory

1. Use the DISPLAY switch to select either TC or UB to preset.

2. Hold the MODE switch in the SET position for 1-second.

3. After 1-second either one or two characters will begin flashing; two characters if presetting TC, one character if presetting UBs. Also, either the PRE1, PRE2, or both colon LEDs will be illuminated. If PRE1 is ON, then the displayed value has been recalled from the PRE1 memory. If PRE2 is ON then its recalled from the PRE2 memory.

If both the PRE1 and PRE2 LEDs are ON then it's simply whatever time or user bit value was in the time code generator at the time that the MODE switch was first held in the SET position.

4. Continue actuating SET and after 2-seconds the ON condition of the PRE1 and PRE2 LEDs will change and the associated preset value will be recalled and loaded into the TCG. The sequence is PRE1, PRE2, both, and it will continue to repeat as long as the MODE switch is held in the SET position.

4.32 Changing the Preset Memory Values

1. Perform the preceding four steps and, while performing Step-4, release the MODE switch from the SET position when the desired PRE1, PRE2, or both LEDs are ON. This action selects the preset memory.

2. After releasing the SET switch in Step-1 above, use the momentary action COUNT switch to increase or decrease the value of the flashing character. The COUNT switch (+) increases the value, (-) decreases it.

3. If the character that is flashing is not the character you desire to change, then actuate and release the SET switch again to advance the flashing from left to right until you reach the desired character position.

4. Continue to use the SET and COUNT switches to select characters and change their value until you have preset all of the characters as desired.

Note that each time you change to a different character you have 2-seconds to change it's value. After 2-seconds the Preset mode is terminated. However, it can quickly be restarted simply by holding the MODE switch in the SET position for 1-second.

5. It should be noted that in the above Step-1 that the first preset value recalled after the 1-second delay is the last preset value that was used. For example, if PRE2 was used to preset the TCG, then whenever the Preset cycle is started by again by holding the MODE switch in the SET position for 1-second, the TCG will be preset to the PRE2 value first. Once this happens, SET can be released and the TCG will be ready to be again started from whatever preset value was stored in the PRE2 memory.

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 1.2

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 525line, 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 signal that occurs once-per-second.. Also sometimes written as 1-PPS. The 1-PPS 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 “ SMPTE Time Code” in paragraph 1.2.

TCR Time Code Reader – reads (decodes) SMPTE time code. The TRG-100 incorporates an internal multi-frame-rate SMPTE time code reader., sometimes referred to in this manual as the “TRG-100 TCR” or just the “TCR”.

TCG Time Code Generator - generates SMPTE time code. The TRG-100 incorporates a multi-frame-rate internal SMPTE time code generator, sometimes referred to in this manual as the “TRG-100 TCG” or just the “TCG”.

UB User Bits - See “SMPTE Time Code” in paragraph 1.2.

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 resulted from the need to slow down the 30 FPS B/W frame rate of TV in the 1950's by 0.1% in order to make color TV more "compatible" with and watchable on B/W TV sets already in use. The 0.1% slowdown results in a frame rate of 29.97 FPS, which is simply 30 x 0.1% = 0.030 FPS, and 30 FPS (-) 0.030 FPS = 29.97 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.

There is more about this in later paragraphs.

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 FPS (-) 0.024 FPS = 23.976 FPS. Used in various video and film recording, editing, and transfer applications.

Time Code for HD Frame Rates - 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).

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 MAINTENANCE

6.1 Cleaning

1. Do not attempt to disassemble your TRG-100 to clean it.

2. Clean your TRG-100 using only a damp cloth.

3. NEVER use water or solvents such as alcohol, window cleaner, etc., to clean your TRG-100.

6.2 Service and Troubleshooting

If you suspect your TRG-100 is not operating properly, check the following:

1. Check all video and time code coaxial cables and connections for opens or shorts.

2. If using an AC power adapter different from the one supplied with the TRG-100, make sure it supplies the TRG-100 with at least 9 volts (maximum of 12 volts) when the TRG-100 is switched on.

You may return your TRG-100 to HORITA for service. Please contact HORITA first, either by phone or mail, before returning your unit.

Note that there are no adjustments or user serviceable parts inside the TRG-100.

7 SPECIFICATIONS

NOTE: us = microseconds, ms = milliseconds, mA = milliamp, mV = millivolt

Power

Operation	9-to-12V DC, apprx. 300 mA.
Connector	Mini phone plug, 3.5mm (0.125"), center positive
AC Adapter	9 volt, 500 mA.

Video/Tri-Level Sync

IN/OUT	
Level	Standard definition NTSC or PAL 1V P-P composite video, HD Tri-Level Sync input
Connector	BNC - Looping, must be externally terminated at 75-ohms for proper operation

Un-Balanced Time Code

IN - Level	200mV-to -10V P-P
Connector	RCA
OUT -Level	1.6V P-P square wave. Rise time approximately 35us
Connector	RCA

Balanced Time Code

IN - Level	Balanced +/- 200mV to +/- 10V P-P square wave.
Connector	Female XLR-3, 1=GND, 2=TC+, 3=TC-
OUT - Level	Balanced +/- 1.6V P-P square wave. Rise time approximately 35us
Connector	Male XLR-3, 1=GND, 2=TC+, 3=TC-

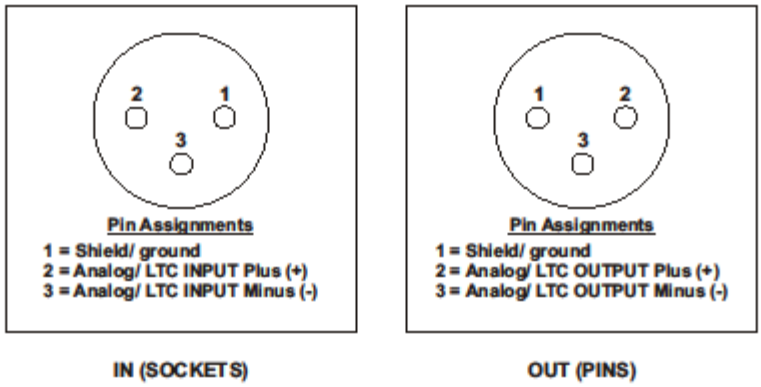

Figure 7-1, Balanced Time Code XLR-3 Pin Connections

Frame Rates

TCG	Generates time code at 23.976, 24, 25, 29.97DF, 29.97NDF, and 30 FPS
Video/TCR Genlock	+/-1 TCG bit time maximum
1PPS Genlock	Frame 00 +/-2.5ms maximum
Free-run Stability	Maximum drift of +/- 1-frame-per-hour over operating temperature range
TCR	Reads 23.976, 24, 25, 29.97DF, 29,97NDF, and 30 FPS SMPTE Longitudinal time code from approximately 1/10 play speed up too 10X play speed. For TCG time code genlock the TCR reads time code at "play speed" +/- apprx. 15%.

Auto Frame Rate Detect	Measures and displays the frame rate of the time code that the that the TCR is reading and differentiates between 23.976 FPS and 24 FPS, and 29.97 FPS and 30 FPS.

Switches

POWER ON/OFF	Toggle switch
MODE, COUNTK	Momentary action toggle switch
GENLOCK, DISPLAY	Toggle switch

Environment

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

Dimensions

Desktop	1.75"H, 3.5"W, 4.5"D
Rackmount	1.75"H, 19"W, 7"D

Weight

Approximately 15 Oz. including power adapter.

NOTE: Specifications are subject to change without notice