TCG
Time Code Generator
Software option for the SR-112

Owner's manual
Version 4.00
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1. Introduction

The TCG option enables the SR-112 to generate time code, locked to an external video reference or not, for multiple applications:

- Generate new master time code, at any standard rate;
- Re-generate existing time code, locked to external video or not;
- Delay time code up to 60 msec (useful when aligning audio to video)

2. Installation

Be sure to update your SR-112 with the latest firmware (for information, please refer to pages 16-19 of the SR-112 User's Manual).

Once you have registered your TCG purchase, you will receive a unique authorization key, a series of 4 numbers, separated by periods. This key is only valid for the SR-112 with the serial number used during ordering.

Enter this code via Menu 98 (see page 8) then reboot your unit. This authorization procedure only needs to happen once, even with subsequent firmware updates.

3. Quick Start

3.1. GENERATE NEW TIME CODE

- Menu 01: select GENERATE
- Menu 10: select the time code FORMAT
- Menu 11: select VIDEO REFERENCE (if required)
- Menu 13: set the START time
- Press the [GEN RUN] key on the front panel

3.2. REGEN TIME CODE

- Menu 01: select REPAIR
- Menu 10: select the time code FORMAT
- Menu 11: select VIDEO REFERENCE (if required)
- Menu 20: select COPY

3.3. JAM SYNC TIME CODE

- Menu 01: select REPAIR
- Menu 10: select the time code FORMAT
- Menu 11: select VIDEO REFERENCE (if required)
- Menu 20: select JAM

Note: Press the [ENTER] key prior to exiting a menu or to exiting the SET UP mode. No change will take place until the [ENTER] key is pressed.

4. Modes of Operation

The TCG brings 2 new modes of operation: GENERATE and REPAIR (see menu 01).

4.1. GENERATE

In this mode, you can generate any format time code, locked to the SR-112 internal crystal or referenced to an external video (SD or HD).

4.2. REPAIR

Repair has 3 options: COPY, JAM and SHOW:

- COPY: the generator continuously copies the time code input, as long as it continues to increment. It is the default value of the REPAIR mode.

This is used for eliminating drop-outs and reducing jitter on existing code.

- JAM: a one-time copy of the input time code is transferred to the generator shortly after the input time code achieves play velocity. The generator then increments as it would in GENERATE mode.

This is used for generating new code from a known start point.

- SHOW: a special setting for live shows where no frames are skipped or duplicated (see page 9: Repair Modes).

GENERATE to VIDEO REF and REPAIR modes can be used in conjunction with the DELAY feature as described in 6.5, menu 12.

5. Status Pages (LCD Display)

With the TCG option installed, your SR-112 has 3 new status pages, in addition to the 5 existing ones:

- TIME CODE INPUT STATUS
- TIME CODE INPUT READER - *NEW* -
- USER BITS IN
- GENERATOR STATUS 1 - *NEW* -
- GENERATOR STATUS 2 - *NEW* -
- VIDEO FORMAT
- TIME CODE/ VIDEO PHASE
- TIME CODE ERRORS

• TIME CODE INPUT READER

Gives visibility to the timecode input at times when the generator takes over the 7-segment display.

• GENERATOR STATUS 1

Indicates the format and the frame rate of the generated time code.

Formats available are 24, 25, 30DF and 30ND.

Rates available are 23.976, 24, 25, 29.970 and 30.

The "XFrm" indicator comes on when the generator is creating 24 frame code locked at 23.976Hz to an NTSC video reference. This is the only cross frame mode currently supported.

• GENERATOR STATUS 2

The bottom line of this page is separated in 3 sections:

Left: Indicates the Repair option selected in menu 20 (Jam/Copy/Show)

Center: Indicates the Generator Delay in milliseconds.
   The "DLY=xx" segment illuminates only when a delay has been requested via the "Gen Delay" menu 12.

Right: Indicates the lock status of the regenerator (Unlk/Lock)

To access these different pages, press the [UP] or [DOWN] key.

5.1. STATUS PAGES & OPERATING MODES

Some of the status pages are only available in certain modes, as shown in the following table. When switching to another mode, the current status display is preserved, but changes to the default (*) if the current display is not available in the new mode.

Status Display	Operating Modes		
	Reshape	Repair	Generate
TIME CODE INPUT STATUS	Y*	Y*	-
TIME CODE INPUT READER	-	Y	-
USER BITS IN	Y	Y	-
GENERATOR STATUS 1	-	Y	Y*
GENERATOR STATUS 2	-	Y	Y
VIDEO FORMAT	Y	Y	Y
TIME CODE / VIDEO PHASE	Y	Y	-
TIME CODE ERRORS	Y	Y	Y

6. Menus Description

6.1. MENU 01: MODE

With the TCG enabled, the SR-112 has 3 different operating modes: RESHAPE (default value), GENERATE and REPAIR. A corresponding LED illuminates on the front panel (Status Section) to indicate the current selection.

Note: *Menu 01 only appears when the TCG software option has been installed since, without it, Reshape is the only mode available.*

6.2. MENU 09: ALTERNATE PHASE WITH 50&60Hz VIDEO

Menu 09 allows the user to switch "A"/"B" phases when working with a 2x rate video input. See chapter 14 for more information.

6.3. MENU 10: GENERATOR FORMAT

Select from the following options the type of time code to be generated:

- 24   at a rate of   23.976
- 24   at a rate of   24.000
- 25   at a rate of   25.000
- 30DF   at a rate of   29.970
- 30ND   at a rate of   29.970
- 30DF   at a rate of   30.000
- 30ND   at a rate of   30.000

This menu indicates settings. For Status, exit SET UP and go to 'GEN STATUS 1'.

6.4. MENUS 11: GENERATOR VIDEO REF

```
11 Gen Vid Ref
    On
```

This selection determines if the generator is video referenced or not.

NOTE: If VID REF is selected in menu 11 but no video is present at the rear panel connector, the front panel VIDEO REF LED will blink continuously.

6.5. MENUS 12: GENERATOR DELAY

```
12 Gen Delay
    10 millisec
```

Menu 12 lets you enter a value in milliseconds to delay the generator output in 'REPAIR' or 'GEN w/ video ref' modes. This value goes up to 60 milliseconds.

This function is useful to delay the audio when it is ahead of the video.

The "Gen Delay" menu is unique in that the generator delay is dynamically adjusted as the menu value is incremented or decremented. It is not necessary to press the [ENTER] key for the new value to take effect.

When the TCG starts running and a delay has been requested, the 7-segment display indicates "Gen dly" for about 2 seconds (see 11.1).

```
GEn dLY
```

This requested delay appears in the GEN STATUS 2 page (see page 4).

6.6. MENUS 13: GENERATOR START TIME

```
13 Gen Start
    23:59:59:29
```

This sets the frame number at which the TCG starts when [GEN RUN] is pressed.

6.7. MENUS 14: GENERATOR USER BITS

```
14 Gen UB
    00.00.00.00
```

This sets the User Bits of the generated time code.

6.8. MENUS 20: REPAIR MODE

```
20 Repair Mode
    Copy
```

Three Repair options are available: COPY (default), JAM and SHOW.

- COPY: the TCG continuously reads the time code input and regenerates the exact same numbers.
- JAM: a one-time copy of the input time code is transferred to the generator shortly after the input time code achieves play velocity. The generator then increments as it would in GENERATE mode.
- SHOW: a setting made specifically for live shows where no frames are duplicated or skipped.

See chapter 8 for more on the repair options.

6.9. MENUS 21: REPAIR FLYWHEEL TIME

If the source time code drops out or becomes unreadable, the TCG repairs this by flywheeling over the 'bad' area, generating good code.

```
21 Rep Flywheel
    5 frames
```

Menu 21 sets the interval of time during which this happens. The choices are: 5fr, 15fr or infinite. Default value is 5 fr.

This setting applies to Copy and Jam only. In Show mode, flywheel is always forced to infinite (see 8.3).

With infinite selected, after 15 fr of input code gap, the generator is in 'free run' and the GEN RUN LED blinks continuously (Copy and Jam only). To stop the generator, press the [GEN RUN] button.

6.10. MENUS 22: REPAIR RAMP UP TIME

```
22 Rep Ramp Up
    9.5 seconds
```

During the "Ramp Up" period the generator is inactive, and input code is switched to the outputs as it would be in RESHAPE mode. Only at the end of the "Ramp Up" period does the generator start to actively seek an opportunity to begin jamming input time code into the generator stream.

Default "Ramp Up" is "None" and can be adjusted from "None" to 9.5 sec with 0.5 sec increments.

6.11. MENUS 23: REPAIR INPUT PERSISTENCY

```
23 Rep Persist
    5 frames
```

The "Persistency" is the number of consecutive frames that the input time code must be seen to be incrementing normally before the generator jams the input time code into the generator stream.

The default value is 5 frames. It can be adjusted from None to 99 frames.

In "Copy" mode, the generator jams the input time code as long as the input time code continues to increment.

```
23 Rep Persist
    None:No Comp
```

There are two special "Persist" settings:

- "None" means that there is no requirement for the input time code to be incrementing at all, and that the generator will use any valid number that it receives.

- "None:No Comp" is the same as "None", but the usual methods of incrementing time code to compensate for internal reader and generator delays is discarded. The input time code is transferred unaltered to the generator stream and in that way, as long as input time code remains valid, every input frame will be accounted for in the output stream.

The disadvantage of this mode is that there is a two (2) frame delay between the input time code and the output generator code.

6.12. MENUS 24: REPAIR TIME CODE JAM WINDOW

```
24 Rep Window
  ▓25% frm[vid]
```

The repair "Window" setting is used only while the generator is locked to a video reference and while it is copying or jamming from input time code. It specifies, as a percentage of a frame, the size of the "window" on either side of the video frame edge within which the input time code frame edge must fall before the input code will be recognized by the generator.

The default 25% should be perfectly adequate to accommodate time code which is not quite correctly in phase with the video reference. If however, for example, the input time code is locked to the wrong video field, then it may be necessary to open up this "window" to 50% or higher.

6.13. MENUS 25: SHOW CUE

```
25 Show Cue
  ▓Back only
```

In SHOW REPAIR mode, the TCG automatically re-jams when the TC source jumps to a new location (or Cue), such as the beginning of the show for example. To avoid an accidental re-jam during a live show, menu 25 lets you restrict the direction of that jump. Options are 'Back Only', 'Forward Only', and 'Back and Forward'. A 4th option, 'Off', disables automatic re-jam altogether. Default value is 'Back Only'.

6.14. MENUS 26: SHOW CUE MINIMUM

```
26 Show Cue Min
  ▓   10 minutes
```

In SHOW REPAIR mode, menu 26 sets the minimum distance required between the input time and the generator time (in minutes) before a complete re-start can be initiated when the input code jumped to a new location, as described in 6.13 above. Default value is set at 10 min.

6.15. MENUS 98: FEATURE KEY

```
98 Feature Key
  ▓0.12.34.56
```

Menu 98 lets you enter a unique key to authorize certain features on your SR-112, such as the TCG.

For more information, see 'Installation' page 2.

!

IMPORTANT NOTE ON MENU OPERATION:

Remember to always press the [ENTER] key to save your settings prior to exiting a menu or to exiting the SET UP mode.

No change will take place until the [ENTER] key is pressed.

---

7. Repair Flywheel Stages

In Repair mode, flywheeling happens when the time code source disappears (drop-out) or becomes unreadable, and new time code is generated. The flywheeling duration is set in menu 21. Choices are 5fr, 15fr and Infinite. There are 2 stages of Flywheel:

7.1. FLYWHEEL Stage 1

With 5 or 15fr selected (COPY and JAM only), the generator continues to run through the input gap (of either 5 or 15 frames), and then:
- returns to normal Repair mode if timecode re-appears,
- stops if it doesn't.

7.2. FLYWHEEL Stage 2

With 'Infinite' selected, after the input gap of 15fr has expired (stage 1), the generator is in free run. This Infinite Flywheel state is indicated by:
- a continuously flashing GEN RUN LED in JAM or COPY modes, or
- a continuously flashing GENERATE LED in SHOW mode.

During Infinite Flywheel, to stop the generator, press the [GEN RUN] button while in COPY or JAM modes and hold it for 2 seconds while in SHOW mode.

8. Repair mode options

Three options are available in Repair Mode: COPY, JAM and SHOW. They are set in menu 20.

8.1. REPAIR - COPY

In COPY mode, once the generator starts running, timecode is transferred continuously to the generator time register as long as the input code is coherent and within all the required windows (menus 23 & 24). This generator synthesized output has all bits and frame edges in the right places, but uses the timecode numbers from the input stream, assuming they are coherent.

During an input dropout the generator will continue to increment.

If the input time code jumps to a new location, the generator will follow these numbers, so long as they are coherent.

8.2. REPAIR - JAM

In JAM mode, timecode is transferred from input code to generator only ONCE when input code starts up. After that, the input numbers are completely disregarded.

During an input dropout the generator will continue to increment.

A jump to a new location will have no effect on the output since the generator disregards the input numbers.

8.3. REPAIR - SHOW

SHOW mode is for live shows where it is crucial that no frames are either

duplicated or skipped. In this mode, the Flywheel setting is forced to 'Infinite' (menu 21).

During an input dropout, the generator continues to increment at the last known rate, equivalent to JAM with infinite flywheel.

When input time code re-appears, the generator does NOT re-jam to the input numbers. Rather it gradually re-aligns its output frame edge to the nearest incoming TC frame edge. This means that it is possible that the output frame number may not end up being identical to the input TC frame number.

But, if the input time code jumps to a new location, the generator will automatically re-jam as long as the input timecode jumps:
    - in the direction set in menu 25, and
    - by an amount greater than the minimum CUE distance set in menu 26.

8.4. MANUAL RE-JAM IN SHOW MODE

If the [GEN RUN] button is held down for 2 seconds or more, the SR-112 will execute a "RE-JAM" function, in which input time code from the Reader, if present, will be instantaneously copied into the Generator time code.

While this function is operational in JAM mode, it is primarily intended for the SHOW mode. (It doesn't do anything useful in COPY mode.)

It is also the only way, while in SHOW mode, to stop the generator when the input time code has stopped and the generator has entered the Infinite Flywheel state. JAM and COPY modes allow a single press of the [GEN RUN] button to do this, with the GEN RUN LED flashing to indicate that the button is armed, but SHOW mode does not.

No status display or message is generated when the re-jam takes place, but the GEN RUN LED will blink off momentarily when the action occurs. Typically therefore the operator will hold the button until the LED blinks.

The re-jam function may be additionally delayed if the generator is not frame locked at the time the re-jam is requested (the GENERATE LED would be flashing to indicate the unlocked condition), and in this case the GEN RUN LED will turn off when the re-jam request is recognized, and turn back on again when the re-jam actually takes place.

9. Generator Switch and LED's

The front panel switch and LED's have different functions depending on the SR-112 mode of operation (Reshape / Repair / Generate). Here is a description of each under the 3 different modes. Brackets are added to indicate that operation is identical in REPAIR and GENERATE (VIDEO REF LED and GEN RUN LED).

Note that the "TC IN", "OUT OF PHASE" and "DRIFTING" LEDs are disabled in GENERATE mode.

9.1. GENERATOR RUN SWITCH

RESHP: Ignored
REPAIR: Stops Generator when in Infinite Flywheel
GEN: Starts / stops generator

9.2. VIDEO REF LED

RESHP: Off
REPAIR ⎤ ⎡Off: Generator is not video referenced
/GEN: ⎦ ⎢On: Generator is video referenced
           ⎣Blink: Generator is in VIDEO REF mode but no video is present.

9.3. GENERATOR RUN LED

RESHP: Off
REPAIR ⎤ ⎡Off: (generator not running)
/GEN: ⎦ ⎢On: Generator is running, and generator code has been switched to
           ⎢   the outputs
           ⎣Blink: Generator is running as above, but has entered the infinite
                       flywheel state (Copy & Jam Repair only - see 7.2).
                       - to stop the generator press the [GENRUN] key.
Note: if the input code has started running again prior to pressing [GENRUN], then the generator will at that time re-sync and re-jam.

9.4. RESHAPE LED

RESHP: On
REPAIR: Normally off
          But blinks when generator is bypassed and input
          code is active (typically during jam/copy ramp up
          or if input code is not within menu 23 or 24 specs)
GEN: Off
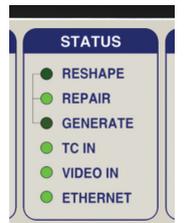
9.5. REPAIR LED

RESHP: Off
REPAIR: On
GEN: Off

9.6. GENERATE LED

RESHP: Off
REPAIR: Normally off, but
          - illuminated solidly when either:
               (a) generator has entered flywheel mode (source stopped)
            or (b) generator is in jam mode and past the jam point
          - flashes (Show Repair only) during Infinite Flywheel after input has
               stopped (see 7.2 above)
GEN: Normally on
          - but blinks if Video reference is selected and generator is not cur-
               rently locked to the video (or no video is present).

10. Errors - LCD Display (status pages)

10.1. GEN STATUS 1

The timecode type and/or rate values in the GEN STATUS 1 page will blink continuously to indicate a generator settings mismatch. For example, when

generating '30DF 30.000' referenced to 29.97 NTSC video.

```
↕ Gen Status 1
      30DF 29.970
```

For more information on GEN STAT errors, see 11.2 below.

10.2. GEN STATUS 2

The "Copy", "Jam" or "Show" indicator in the GEN STATUS 2 page will blink in REPAIR mode when the Generator is *attempting* to copy or jam input timecode.

```
↕ Gen Status 2
Jam            Lock
```

While blinking, the Generator is waiting for:

• the input timecode edge to fall within the "Repair Window" specified in Menu 24 and
• the input timecode to increment persistently as specified in Menu 23.

Continuous blinking indicates a problem in one of these areas. The problem might be solvable by adjusting either Menu 23 or Menu 24, or it might be that the situation is simply impossible.

Confirming that the generator is unable to perform the repair, the RESHAPE LED will blink continuously as well (see 9.4 above).

11. Error Messages - 7-Segment Display

In addition to the timecode reader errors reported by the SR-112 (see SR-112 User Manual 11.3), the TCG has some new error messages.

Note that timecode Reader errors are disabled in GENERATE mode.

11.1. GENERATOR DELAY

```
GEn dLY
```

This message (informational, not an error) is displayed when generator starts running and a delay has been requested in menu 12 (Repair, or Generate to Vid Ref only)

11.2. GENERATOR SETTINGS MISMATCH

```
GEn StAt
```

This message indicates a condition where the current TCG timecode type and/or rate is not the same as the "Gen Format" menu setting (menu 10).

For example, generating '30DF 30.000' locked to 29.97 NTSC video.

The generator will use the timecode type and rate from the menu setting until such time as the requisite video and/or timecode inputs are connected. At that time it may have to adjust the generated type and rate if the menu values are incompatible with the video and/or timecode inputs. This is when the GEN-STAT error would be established.

The timecode type and/or rate values in the "Gen Status 1" status display will also blink continuously to indicate the mismatch.

```
↕ Gen Status 1
      30DF 29.970
```

It is important not to confuse Menu 10 and the Gen Status 1 page. Menu 10 indicates a setting not a status. The Gen Status 1 page will indicate the actual format and rate of the generator output and flash if it doesn't match the settings of menu 10.

```
10 Gen Format
  ▮30ND 30.000
```

11.3. CODE - VIDEO

```
CodE-UId
```

This error, active in Repair mode with video reference only, indicates that the input timecode type cannot be matched up with the video rate.

This is re-assessed every time the input timecode enters play motion, or following a timecode type change, or when a reference is first recognized at the video input.

11.4. GENERATOR SYNC

```
GEn SYnC
```

This message is displayed in case of a Generator Sync Error (very unlikely).

11.5. GENERATOR FAILURE

```
GEn FAIL
```

This message is displayed in case of a Generator Internal Failure (even more unlikely).

12. Error Messages - Other

The following time code input errors will not be shown on the 7-segment display while the Generator is running. They will however still be added to the error report listing.

"CODE ERR"	-	Code Error
"CODESTOP"	-	Code Stopped
"CF CHG "	-	Color Frame Change
"DF ERR "	-	Drop Frame Error
"DISCONT "	-	Discontinuity
"DF CHG "	-	Drop Frame Change
"DROP OUT"	-	Code Drop Out

"TYPE CHG"   -   Code Type Change
"INVALID "   -   Invalid Address
"REPEAT "   -   Repeated Frame

13. Non-Volatile Storage

The SR-112 has non-volatile memory holding the current settings, including all the TCG settings. This memory is continuously updated so that, when the unit is turned on, it is in the same condition as it was when powered down.

NOTE: You should wait approximately 10 seconds after a change was entered before powering down, to allow for the flash memory to be updated.

14. Genlocking to a 50/60 Hz Video Reference

SMPTE time code was developed for analog television operating with rates up to 30 f/s. With digital television, progressive video systems have frame rates up to 50 and 60 f/s. In these systems, counting is done on frame pairs and the video reference point is the start of line 1 of the first frame of the frame pair to which the LTC is associated.

When using 2x video rates (50, 59.94, 60Hz) for synchronizing the generator frame, the TCG extracts a 1x rate (25, 29.94, 30Hz) from the video, and it does this by arbitrarily discarding every second input video frame edge. Conceptually the input video frame sequence can be thought of as a sequence of pairs of frames, with the first frame of each pair denoted as "A" and the second as "B". (This is a purely imaginary construct of course, as the frames themselves are indistinguishable one from the other.)

14.1. MENU 09

When the SR-112 first powers up, if a 2x video rate is selected as its reference, then it will initially lock to the "A" frames and discard the "B" frames. This will normally be a satisfactory arrangement, but it is possible that the SR-112 will be using the "A" frames when the user would prefer that the "B" frame edges are followed. This may come up, for example, when the output timecode turns out to be 180 degrees out of phase with other pieces of equipment that have landed on the alternate video phase.

Menu 09 lets you switch "A"/"B" phases. The "A" or "B" values have no particular significance. The menu simply allows the phase to be reversed from its current orientation.

```
09 Vid 2x Phase
 A  [50-60Hz]
```

Where adjustment is required, menu 09 may have to be re-adjusted every time the SR-112 is powered up and/or every time that a new 2x video reference is either selected or plugged into the SR-112 reference video input.

15. Option Card - Serial Port - SP/SR112

As an option, a serial port adapter can be installed in the SR-112 that allows you to remote control the TCG.
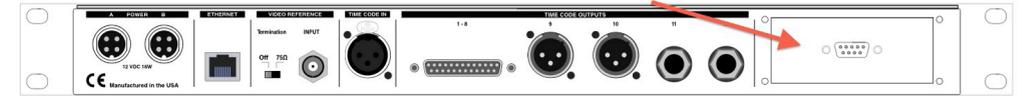
The command list includes all the set-up functions such as Format and Start Time, as well as commands such as START and STOP. Current time feedback over serial is also available.

The ordering number is SP/SR112. It includes the serial adapter (DB9) attached to a new insert panel with cables and mother board connector, as well as a complete protocol description. Installation is very simple and can be done in the field with the usual precautions.

NOTE: Firmware 4.00 or later is required for serial control.

For more information, please contact your Brainstorm dealer.